COMMODORE REDUX
Replica C64 outside; modern PC inside! PG. 60

SAMSUNG SERIES 9
Ultraportability in a 15-inch chassis. PG. 70

GEFORCE GTX 690
Dual GPU is as powerful as it is purty! PG. 36

MAXIMUM PC

MINIMUM BS • AUGUST 2012 • www.maximumpc.com

100

Tips and tricks for a smarter, faster OS
PG. 24

WAYS TO *SPEED UP* WINDOWS

#5 Manage the Services that run in the background

#17 Set your PC to boot with greater speed

#43 Search the web from your Start menu

#86 Customize your Favorites folder

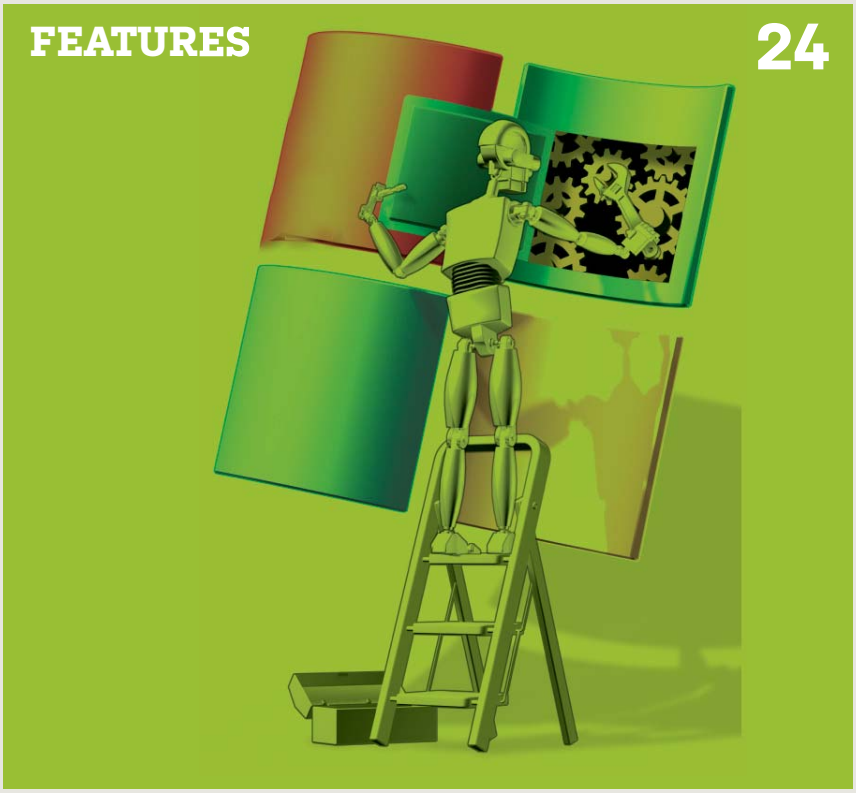
HOW TO: Install Android on your PC—for the heck of it!

$7.99US
08
Future MEDIA WITH PASSION
0 72440 38753 9

inside
AUGUST 2012

On the Cover
Illustration by
Giacomo Marchesi

FEATURES



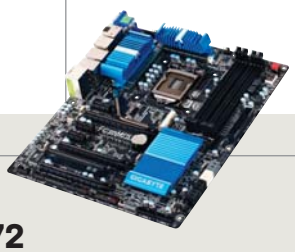
QUICKSTART

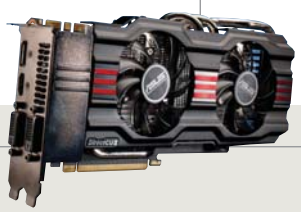
FB buys Twitter. Not.

R&D

LETTERS

IN THE LAB





MORE +

MAXIMUM PC

EDITORIAL
Editor-in-Chief: Katherine Stevenson
Deputy Editor: Gordon Mah Ung
Senior Editor: Nathan Edwards
Online Managing Editor: Alex Castle
Contributing Writers: J.R. Bookwalter, Michael Brown, Loyd Case, Brad Chacos, Tom Halfhill, Paul Lilly, Thomas McDonald, Graham Morrison, David Murphy, Quinn Norton, James Stables
Copy Editor: Catherine Hunter
Podcast Producer: Andy Bauman
Editor Emeritus: Andrew Sanchez

ART
Art Director: Richard Koscher
Contributing Photographer: Mark Madeo

BUSINESS
Vice President, Consumer Media: Kelley Corten, kcorten@futureus.com
Vice President, Sales & Business Development: Nate Hunt, nhunt@futureus.com
Associate National Director of Sales: Isaac Ugay, iugay@futureus.com
Sales Director, East Coast: Thomas Lundell, tlundell@futureus.com
Account Executive: Austin Park, apark@futureus.com
Advertising Coordinator: Heidi Hapin, hhapin@futureus.com

Marketing & Sales Development Director: Rhoda Bueno
eCommerce & Fulfillment Director: Lisa Radler
Consumer Marketing Manager: Jong Lee
Newsstand Director: Bill Shewey

PRODUCTION
Production Director: Michael Hollister
Production Manager: Larry Briseno
Production Coordinator: Jose Urrutia
Senior Print Order Coordinator: Jennifer Lim

FUTURE US, INC.
4000 Shoreline Court, Suite 400, South San Francisco, CA 94080
Tel: 650-872-1642, www.futureus.com

Chief Operating Officer: Rachelle Considine
Vice President & Chief Financial Officer: John Sutton
Vice President, Internet & Mobile Products: Mark Kramer
General Counsel: Anne Ortel

SUBSCRIBER CUSTOMER SERVICE
Maximum PC Customer Care,
P.O. Box 5159, Harlan, IA 51593-0659
Website: www.maximumpc.com/customerservice
Tel: 800-274-3421
Email: MAXcustserv@cdsfulfillment.com

BACK ISSUES
Website: www.maximumpc.com/shop
Tel: 800-865-7240

REPRINTS
Future US, Inc., 4000 Shoreline Court, Suite 400,
South San Francisco, CA 94080
Website: www.futureus.com
Tel: 650-872-1642, Fax 650-872-2207

Gordon
Mah Ung

THANK YOU, COMMODORE 64

I COME FROM solid blue-collar roots, and throwing money around on something as frivolous as a personal computer in the 1980s likely made no sense to my immigrant parents. Up to that time, their only exposure to technology was the spiffy Texas Instruments calculator my dad bought to literally replace his abacus.

But somehow in 1982 my parents ponied up the $595 to buy me a Commodore 64. It wasn't my first computer, either. Jack Tramiel's C64 followed a VIC-20 purchased two years before for $299.95.

To put those purchasing decisions in perspective, $595 in 1982 buys you $1,418.66 today when adjusted for inflation. That VIC-20? $837.55. While I always thought my incessant whining led to those large outlays of cash, I know now that my parents were investing in my future.

That Commodore 64 and VIC-20 exposed me to programming concepts and taught me typing and word processing. And with the 300 Baud VIC modem, I learned how to troll—er, debate—people on dial-up Bulletin Board Systems. I even learned not to be afraid to grab a screwdriver when things didn't work. Tip: RF insulation made from sloppily cut, foil-coated cardboard isn't a good idea inside a computer, Mr. Tramiel. With 30 years of computing behind me to look back on, I can say that $1,418.66 investment has paid for itself many times over.

Amazingly, I believe the life-changing capability of a personal computer still exists. While other technology toys grab the headlines today, it's the personal computer that still has the ability to take you to magical places. You don't just consume with the personal computer, either, you can also create. From 3D modeling to stunning digital images to programming, and yes, of course, to gaming, the personal computer takes you there.

My own children are being exposed to technology at a far younger age than I was, but I'm going to make certain that their tech experiences aren't just through game consoles, tablets, or smartphones. A personal computer, with its limitless horizons and, yes, its need for maintenance, will also be in my kids' lives. Perhaps I'll take home the Commodore 64 from this month's Build It (page 60) and insist that if they want to check out something on the Internet, they first build the device on which they search for it.

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

↘ submit your questions to: comments@maximumpc.com

THE NEWS

Diablo III: The Dark Future of PC Gaming?

What the launch of Blizzard's action RPG says about our favorite hobby

ON MAY 15, MILLIONS of gamers stayed up late, ready to fire up their pre-downloaded copies of Diablo III. They were excited to return to Sanctuary after a 12-year absence, and to slay hordes of ghouls, demons, and abominations alongside their fellow adventurers. What they got instead was a server error—a message informing them that because Blizzard was struggling with the huge load of players, they would be unable to play the game that was sitting, freshly installed, on their hard drives. Even the single-player game was unavailable, thanks to Blizzard's new form of DRM that requires a constant connection to its servers for any type of play.

The server problems had been mostly resolved by the next day, but the experience raised concerns about several trends in PC gaming.

The first is the new breed of DRM that requires a constant Internet connection. It's effective at preventing piracy and cheating (the Blizzard implementation actually keeps some core game logic on the servers, preventing a simple crack from circumventing the need for a connection), but bad for gamers. The game cannot be played anywhere without an Internet connection, and attempting to play on an unreliable connection is liable to get a gamer kicked out of the game mid-dungeon. Additionally, as the Diablo III launch demonstrated, any problems with the publishers' servers mean it's game over for everyone, whether or not they want to play online.

Welcome to the real depths of hell in Diablo III.

The likely motivation behind Blizzard's new DRM, and another worrying trend in PC gaming, is the Diablo III real-money auction house. Whereas Blizzard's stance in World of Warcraft has always been that it's against the terms of service to trade in-game goods for real money, it's done an about-face in Diablo III, creating a sanctioned online auction house where players can buy and sell game items for cold, hard cash.

Blizzard will take a portion of each sale, amounting to $1 per equipment transaction, and then take another 15 percent if you choose to cash out your account balance. Activison Blizzard stands to make a lot of money from the real-money auction house, as long as the in-game economy remains strong. Of course, nothing can ruin a game's economy faster than cheats and exploits—exactly the sort of thing Blizzard's extreme new DRM prevents.

It could be argued that a more secure online play environment benefits everyone, but is it possible for any company to maintain 100 percent game server stability? If anyone could do it, you'd think it would be Blizzard, who maintains World of Warcraft—the most popular MMO in the world, with more than 10 million players. Further, the company had a good idea of how popular the Diablo III launch would be: It was the most pre-ordered PC game in history on Amazon, and Blizzard itself had given free copies of the game to all 1.2 million World of Warcraft annual pass subscribers, virtually guaranteeing a massive launch.

If it's not possible for a company as big as Blizzard to keep its servers up, what will happen to games by smaller studios that implement the same DRM? What will happen to older games when the companies that publish them no longer want to maintain a server farm? And most importantly, is any of this fair to gamers, who just want reliable access to the games they pay for? **–Alex Castle**

Ivy Bridge: Now with Dual Cores

Lower-power users are finally getting their taste of Ivy Bridge with Intel's new line of dual-core processors based on the 22nm Ivy Bridge cores. Intel has announced that no fewer than 14 dual-core Ivy Bridge processors will join its lineup this summer.

Like their quad-core brethren, the dual-core chips will offer roughly a 10 percent increase in x86 performance when compared directly with Sandy Bridge chips. The graphics core, however, features far more performance, causing Intel to label the Ivy Bridge a "tick-plus" part. Expect these chips to be powering the next generation of Ultrabooks, most likely alongside ultraportables featuring AMD's Trinity APU, which itself should debut by the time you read this. **–GU**

Google, MS Trade Wins, Losses

The geek community at large is pretty loyal to the Google brand, but Bing is picking up steam. According to a Hitwise report, Bing now accounts for 30 percent of all U.S. web searches, and most of the gains seem to have come at the expense of Google. While Bing grew its U.S. search queries by an impressive 11 percent over the last 12 months, Google dropped by the exact same amount.

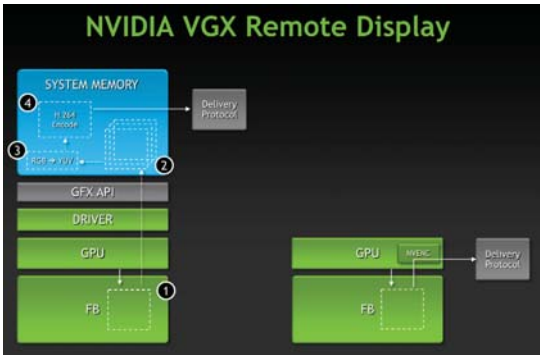
On the other hand, Internet monitor StatCounter reports that Chrome has finally overtaken Internet Explorer as the most-used browser. Other Internet trackers still show IE with the lead, but Microsoft's browser has clearly lost its once-formidable edge. **–KS**

Nvidia Virtualizes Kepler

At May's GPU Technology Conference, Nvidia revealed the GPU virtualization capability built into its Kepler GPUs. The virtualization technology, dubbed Nvidia VGX, enables GPU acceleration of virtual machines. VGX allows server-side Kepler GPUs to render their frame buffers directly to an on-GPU H.264 encoder, which then streams the output to the remote user via, for example, Citrix Receiver. Previous VM and remote-desktop solutions required the local CPU to render the desktop environment, leading to laggy, low-quality desktop environments. The new GPU-accelerated remote desktops and virtual machines will enable power users to get actual work done—or allow up to 100 virtual desktops to be rendered by a single card.

Nvidia also announced GeForce Grid—a tech to deliver streaming games to consumers on thin clients, like phones, tablets, and laptops. Like the enterprise tech, GeForce Grid uses servers with Kepler GPUs to render game video server-side and stream it to clients, relieving the need for powerful hardware on the client end—similar to OnLive's streaming game service. Nvidia's GTC demo of GeForce Grid included a gamer playing Hawken on a TV against one playing on an Ultrabook, using the Gaikai cloud gaming service, which runs on GeForce Grid servers.

One thing Nvidia didn't mention, but we'd like to see, is whether consumer Kepler cards can utilize VGX. We envision a world in which a gamer can remote into his or her desktop PC from a smartphone or tablet and play games accelerated by the desktop GPU. **–NE**



By encoding the video output to H.264 directly on the GPU, Kepler can stream high-quality GPU-accelerated video to any device.

Tom Halfhill
Fast Forward

PARALLEL PROGRAMMING FOR DUMMIES

PARALLEL PROGRAMMING seems like rocket science to most people, but even rocket science can be made easy. Heck, I was building and launching model rockets as a teenager.

Intel has invented the model rocket of parallel programming. An Intel Labs project, code-named River Trail, has created a JavaScript extension that brings data parallelism within reach of millions of ordinary programmers. If an international standards body approves, the extension could appear in all web browsers that support JavaScript, which is virtually all web browsers. (Don't confuse JavaScript with Java, a completely different language.)

River Trail is surprisingly simple and powerful. It adds one new array type (ParallelArray) and nine methods for manipulating the array's data. It's so simple that Intel's technical document is only 17 pages long. (My digital camera manual is 150 pages.) Yet River Trail can use multiple CPU cores per chip, multiple threads per core, multiple processors per system, and multiple-data instructions, such as those in Intel's SSE and AVX extensions. The latest version even uses the GPUs in Ivy Bridge processors.

The best part is that JavaScript programmers see none of this complexity. They simply put their data into a ParallelArray and call one of the nine parallel-processing methods (or multiple methods). At run time, the JavaScript extension finds any parallel resources available in the system and uses them to crunch the data.

Yes, programmers must learn some new concepts and rewrite some code. River Trail isn't the long-sought "magic compiler" that automatically converts existing sequential code into parallel code. And JavaScript is a relatively slow language, so River Trail isn't the swiftest solution. It's a model rocket, not a Saturn V.

But the basic technology is applicable to other programming languages, and it really works—I've tried it. Someday, River Trail may bring parallelism to the masses.

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

Thomas McDonald
Game Theory

WEAPONIZING ONLINE REVIEWS

WHEN POPULAR opinion and critical reviews are at odds, it's worth trying to learn who's to blame: a suppliant press, or a raging and infantile fanbase?

Or, in the case of Diablo III, a bit of both.

I don't think always-on DRM is such a hot idea, but it's Blizzard's game, and if they feel it's necessary to protect the integrity of both the product and the forthcoming real-money auction house, and can get it to work, that's their call. At this late date, no one is buying Diablo III without foreknowledge of the DRM issue, so you either suck it up knowing that's the price of admission, or you just shut up about it and buy another game.

Or, you choose option three: Spam public review sites with hostile "reviews," calling D3 a horrible, awful, hateful sack of pus that probably causes cancer and shingles and kills kittens for fun. And then give it a score of "0," not because of any inherent problems with the design or content, but because you want to punish the publisher.

On the other hand, perhaps if more voices in the mainstream press had paused a little longer over the day-one server problems and DRM complaints, consumers wouldn't have erupted into such a hissy fit.

But probably not. There's a metagame that surrounds every huge, highly anticipated release, and it involves endless complaining, nitpicking, hyperbole, and comment-spamming. Some PC gamers seem to prefer this to actually playing the games.

I'm supposed to understand these outbursts as a form of consumer protest, but this kind of protest is not nuanced thought. It's reactionary. In the case of public D3 reviews, it tells us nothing more than "People don't like DRM."

It also totally compromises the tools that allow the public to evaluate products. It's a way of weaponizing public review systems like Metacritic and Amazon, rendering them incapable of conveying useful information. If consumers want to have some kind of grassroots alternative to mainstream reviews, perhaps destroying the credibility of the online review process isn't the best way to start.

You can follow Thomas McDonald on Twitter: @StateOfPlayBlog.

Via Challenges Raspberry Pi

If you're getting sick of waiting for a slice of your very own Raspberry Pi mini-PC, fear not. Via, the longtime mobo maker, just announced its Pi-like APC 8750 board, a $50 Android-powered PC complete with processor, memory, and a host of I/O ports.

The Via APC fits into any Mini-ITX or microATX case, even though it's based on a new "Neo-ITX" form factor measuring just 17x8.5cm. This particular Android 2.3 Gingerbread variant has been optimized for keyboard and mouse input. The mini-PC sports four USB 2.0 ports and HDMI, VGA, Ethernet, microSD, and audio/mic connections.

The APC rocks an 800MHz Via processor along with 512MB of DDR3 and 2GB of NAND. It's capable of pumping out 720p graphics via its HDMI port; that, combined with the Ethernet connectivity, may just make the APC 8750 an attractive little $50 media streamer for Netflix lovers and HTPC enthusiasts on a budget. Via expects the APC 8750 to start shipping in early July. **–BC**

DDR4 DRAM Coming in 2013, Micron Says

What does the future of memory look like? NAND flash? Hybrid memory cubes? Memory maker Micron has its hands in both of those technologies, but it's also banking on a third form. The company announced that its "first fully functional DDR4 DRAM module" is up and running and should make it to market in 2013.

DDR4 has higher clock speeds and data transfer rates than DDR3 while simultaneously using less voltage than its predecessor, although the final standard for the DDR4 format isn't expected to be formalized until later this year.

Micron plans on rolling out DDR4 RDIMMs, LRDIMMs, SODIMMs, and UDIMMs—enough acronyms for you?—with initial buyers coming from the enterprise and server markets, then trickling down into consumer and mobile markets. Micron hopes to kick the 4GB DDR4 modules into full-on production in the fourth quarter of 2012. **–BC**

LG to Launch Google TV

Are you ready for the second coming of Google TV—the service that lets you conduct searches and access web content from your television? Well, ready or not, Google TV is once again on the horizon, and this time it will be LG making a big push to promote the platform, not Logitech, which had some harsh words for the service after being burned by weak sales and saddled with millions of dollars in unsold inventory. That's all in the past as far as LG is concerned.

"Production of Google TVs will start May 17 from our factory in Mexico, and U.S. consumers will be able to buy the product from the week of May 21," Ro Seogho, a senior LG executive, recently told a handful of reporters, according to Silicon Valley's *Mercury News*. **–PL**

Quinn Norton
Byte Rights

MY WAY OR THE HIGHWAY

WELCOME TO THIS month's column. Are you seated comfortably? Well, stop. Stand up at once, or you'll be guilty of infringing my copyright. That's right, it's part of the terms of using my intellectual property—if you're not standing, preferably uncomfortably, you don't have permission to read my column.

This is roughly the legal theory behind the recent suit filed by the major networks against Dish Networks, who have built a DVR that lets their customers skip commercials when they sit down to watch prime time shows later. But I've decided this is my favorite copyright legal theory, because it gives me, the copyright holder, control over you, the copyright consumer.

The networks have long claimed that skipping commercials is tantamount to theft, because they don't want you to do it. This idea runs afoul of several court decisions, including the famous Betamax case and decisions like Cablevision, which held that Fair Use gives you choices in how and when you decide to watch your TV, and copyright holders can't take that away. But they keep filing suits about it, and winning by bankrupting the other side with legal fees.

Are you still standing? Good. You'll like this next part. The studios went so far as to include details in court filings on how they make money on content—implying that anything that interferes with their business model is de facto copyright infringement.

Dish has sensibly pointed that that all their content is licensed, their equipment is legal, and skipping commercials is probably the most universal of American traditions. But as an intellectual property creator, I'm intrigued by this idea that you have to consume my content my way, so I'm siding with the networks on this one. So, dear reader, as we wind to the end of this column, do the Funky Chicken or I'm suing you.

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

Windows 8 Watch

Tensions Mount as OS Nears

With the Release Preview of Windows 8 now here, excitement is building over the launch of the final product (presumably this fall). Nevertheless, there are some developments to the OS that are already causing concern. Mozilla, for one, is rankled by news that Windows RT, the version of Win8 for ARM, will be limited to using Internet Explorer in the "Windows Classic" environment. Mozilla general counsel Harvey Anderson calls it an "unwelcome return to the digital dark ages where users and developers didn't have browser choices," and he questions the antitrust implications. So far, Microsoft is not commenting on the matter.

According to DigiTimes, low-cost PC vendors are fretting over the pressure they're feeling to incorporate touchscreens into upcoming Windows 8 notebooks in order to take advantage of the Metro interface. The added cost has the potential to price their products out of the mainstream, greatly diminishing demand.

Finally, consumers might be disgruntled by news that Microsoft will charge new Win7 PC buyers $14.99 to upgrade to Windows 8 when it's released, whereas previously such an upgrade was free. The upgrade is to Windows 8 Pro, regardless of the original version. **–KS**

AMD Slackens Catalyst Schedule

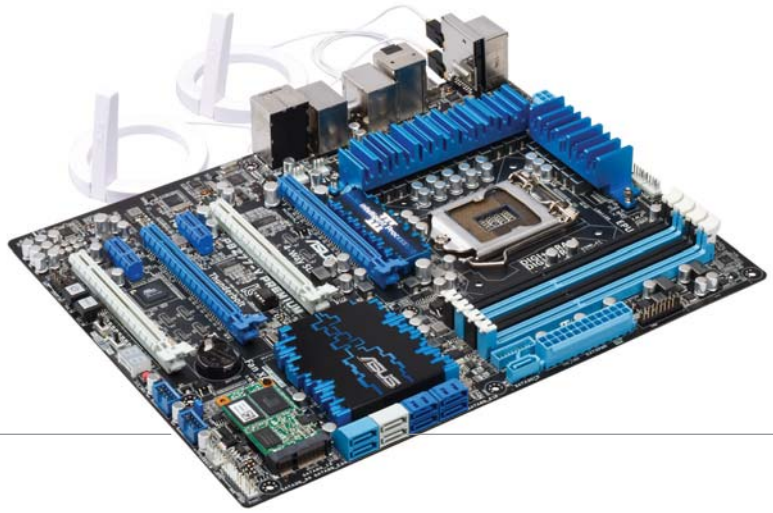
According to a post on AMD's blog, the company is going to cease its stringent monthly GPU driver-release schedule and instead release new Catalyst drivers "when it makes sense." The change starts with Catalyst 12.6, recently released as beta. The move could signal that AMD is much more confident in its driver development, or that the company is feeling stretched for resources. In researching AMD's upcoming dual-GPU card for our GTX 690 story (page 36), a source informed us that the Trinity APU was taking engineers who would otherwise be developing GPU drivers. Of course, if a less frequent driver schedule doesn't leave gamers waiting on much-needed fixes, the reasons for the change don't matter. **–KS**

Thunderbolt Arrives

Intel's vaunted Thunderbolt technology will no longer be exclusive to the Macintosh. Motherboard vendors have begun integrating the high-speed I/O chip into board designs.

Asus, Intel, Gigabyte, MSI, and other board vendors have all announced integration of the new interface. Thunderbolt promises speeds as high as 10Gb/s in each direction, which is theoretically twice the speed of current iterations of USB 3.0. The boards, such as Asus's P8Z77-V Premium (pictured below) are integrating Intel's Cactus Ridge chip, which greatly lowers the price of the controller.

Oddly, Thunderbolt is currently limited to machines with integrated graphics parts, such as Ivy Bridge or Sandy Bridge. That leaves the performance X79 and Sandy Bridge-E parts in the cold. **–GU**

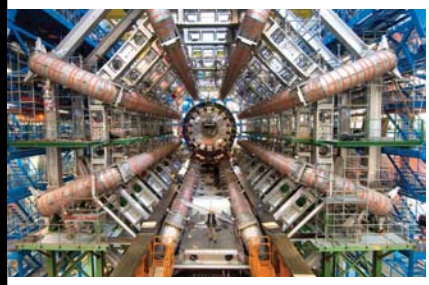


THE LIST

9 TECH RUMORS THAT PROVED WRONG

9 FACEBOOK TO BUY TWITTER

According to the *Wall Street Journal*, in February 2011 Facebook was in talks to buy out Twitter to the tune of $10 billion. It never happened.



8 LARGE HADRON COLLIDER COULD DESTROY PLANET

Nothing but sweet, sweet science was created when CERN turned on the LHC for the first time in 2008.

7 DUKE NUKEM FOREVER FINALLY DEAD

It seemed like the long overdue game might remain vaporware when publisher 3D Realms closed down. Unfortunately for all of us, the Duke lived on.

6 INTEL TO PURCHASE NVIDIA

Scuttlebutt about an acquisition has periodically surfaced over the years, but Nvidia remains its own boss.

5 IPHONE 5

Apple fanboys were positive that a 2011 iPhone 5 would feature edge-to-edge glass, a new teardrop case, and the answer to all their dreams. Maybe the rumors will be right this year... maybe not.

4 THE PIRATE BAY IS GOING TO GO LEGIT

Sure it is.

3 SAMSUNG TO BUY RIM

Despite the rumor that spread earlier this year, RIM seems determined to go it alone.

2 VALVE STEAM BOX

In February, the Interwebz were abuzz with talk of a Steam-branded PC-centric gaming console. Sadly, the so-called "Steam Box" was just a device to test new Steam UI.

1 APPLE TO BUY TIVO

Rumored 2005 purchase never happened. And man, we're all the better for it.

HEAD TO

BY BRAD CHACOS

Google Drive vs. SkyDrive

After years of rumors and whispers, Google finally released its long-awaited Google Drive cloud storage service in April, combining Dropbox-like synching abilities and a PC client with the company's Google Docs service. Microsoft could have waved the white flag; instead, it released an excellent update for its own SkyDrive service, adding many of the features found in Google Drive. The chips are on the table and there's only one question left: Which cloud storage service is better?

Round 1: Interface

Microsoft and Google must've done their homework before launching GDrive and SkyDrive, because the PC and Mac clients for the respective services look and feel an awful lot like Dropbox's. Basically, each appears as just another folder on your computer, albeit a folder that seamlessly syncs with the cloud whenever something inside of it changes. The synched folders even appear in Windows Explorer's Favorites sidebar just like Dropbox's client. It's painless and wonderful.

It's a toss-up on the web interfaces, too. Both have simple, flexible, and functional UIs that deliver all the information you need without being overly busy. Both also feature list- and thumbnail-style viewing options. We prefer SkyDrive's colorful look to Google Drive's drab hues, but that's just a matter of personal taste.

Winner: Draw

Round 2: Storage/Price

New SkyDrive sign-ups receive 7GB gratis—compared to the free 5GB offered by Google Drive—and veteran users can opt to grandfather in their full 25GB of free space. Plus, SkyDrive's upgrade options are cheaper than Google Drive's, and unlike Google, Microsoft offers a 50GB plan.

Google Drive outshines SkyDrive in the total amount of upgradable space available, however. SkyDrive tops out at 100GB, while Google Drive goes all the way up to a whopping 16 terabytes (for a similarly whopping $800/month). Also, Google Drive caps file uploads at 10GB, compared to SkyDrive's 2GB max.

We think 100GB of cloud storage is more than enough for most people, though. SkyDrive's cheaper prices and more generous free storage earn it the win.

Winner: SkyDrive

Round 3: Platform Support

Part of the allure of synching-style cloud storage solutions is the ability to access your files from virtually anywhere. Both services have Windows and Mac desktop clients while neglecting Linux lovers (who'll have to stick to Dropbox). The real difference lies in mobile support: SkyDrive offers dedicated iOS and Windows Phone apps, while Google Drive only has an Android app. Neither has announced plans for BlackBerry support.

As it stands, SkyDrive gets the nod for supporting two mobile platforms, including the über-popular iOS, and for its deep-rooted Windows 8 integration. An Apple-compatible app—which Google says is in development—will add a lot of appeal to Google Drive, though both services pale compared to Dropbox and SugarSync's widespread mobile support.

Winner: SkyDrive

Round 4: Collaboration

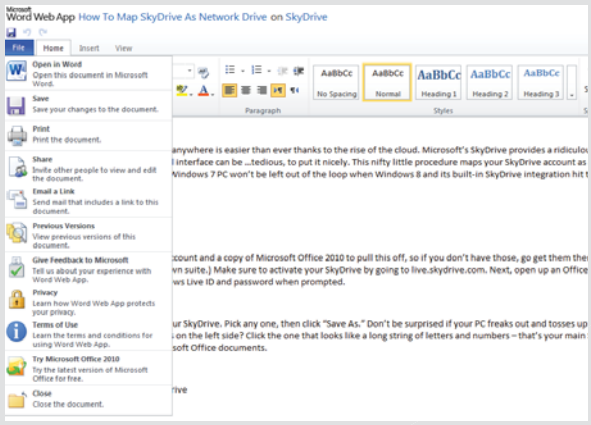
Both services offer basic in-browser editing for documents, spreadsheets, slide shows, and more, and users can collaborate with others to tinker with files in real time. The superb feature sets SkyDrive and Google Drive apart from their competitors.

Giving others permission to read or edit files is a snap in both services, and each gives you the ability to email direct links to specific files. SkyDrive goes the extra mile and includes a Public folder that anybody can access, as well as support for sending links to over 30 social networks (but not Google+).

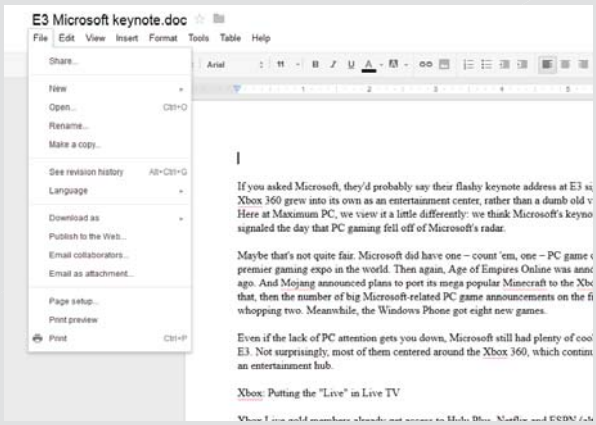
Once you're actually collaboratively editing a document, though, Google Docs presents changes in real time, while SkyDrive's Office Web Apps forces all users to save and refresh documents before showing others' edits. Google's approach is vastly superior.

Winner: Google Drive

HEAD



SkyDrive's Office Web Apps mimic the look and feel of the stand-alone Microsoft Office productivity programs—right down to the controversial Ribbon interface...



... while Google Docs lovers will feel right at home in Google Drive's stark, black-and-white digs. The two services' PC clients, on the other hand, look virtually identical.

Round 5: File Protection

What if, in the midst of a hot-and-heavy collaborative editing session, a clueless co-worker accidentally deletes an important chunk of text and saves the change? Fear not: Both Google Drive and SkyDrive contain handy-dandy version history tools that can restore files to previous iterations. SkyDrive tracks the last 25 versions of a file, while Google Drive maintains file histories for 30 days or up to 100 revisions.

The big difference lies in what happens when you accidentally delete a file completely. In SkyDrive, deleted files are simply gone, never to be seen again. Google Drive, however, moves deleted files into a Trash folder, where you can then choose to delete the file permanently or restore it to its original location, complete with its version history intact if it's a document.

Winner: Google Drive

And the Winner Is...

Sigh. Ties satisfy no one, but individual needs really do determine which of these closely matched cloud-based services is right for you. Google Drive, basically being Google Docs on steroids, holds the slight edge in productivity tasks; SkyDrive is slightly cheaper, offers slightly more free storage, and is available on more mobile platforms. Sign up for the service that supports your mobile platform of choice, or heck, give 'em each a whirl if you're on the fence. Yay freemium!

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

>SSD Migration
>CPU Slowdowns
>Resizing UI Elements

Room for an SSD?

I have a 6-month-old Dell XPS 8300. It came with one 2TB hard drive and I added a second one for automatic backups and some rarely used data, pics, etc. While Windows starts fine, as do apps, I'm sure they would load even faster if I had an SSD, right?

Will my mobo accept an SSD in addition to the two HDDs and two optical drives? There seems to be only one free SATA port on my motherboard since I added the most recent hard drive. Can I "splice" or use a SATA splitter connector to get the SSD to work, or do I need to add a daughterboard for more SATA ports?

Second, what's the best approach for moving my operating system and apps to the SSD? And third, what's a good capacity? I have a 2TB HDD that's about 10 percent full.

—Douglas R. Schafer

THE DOCTOR RESPONDS: You're right, your Dell's microATX mobo has only four SATA ports: two 6Gb/s SATA and two 3Gb/s SATA. However, the SATA spec does allow for port multipliers. So if you want to add an SSD, you can buy a SATA port multiplier or a PCIe SATA card, or simply unplug one of your existing drives. The cheapest option, of course, is to unplug one of your optical drives. The next least expensive, and the one we recommend, is to buy a PCIe SATA card. You can get a card that turns a spare x1 PCIe port into two 6Gb/s SATA ports for about $20.

Make sure your SSD is plugged into one of the 6Gb/s SATA ports on your motherboard or the PCIe card, so you can take advantage of the higher speeds of third-generation SATA. Use the 3Gb/s SATA ports (SATA 2.0) for your optical and backup drives.

We'd say a good capacity for an SSD is around the 240-256GB range. Not only are most modern SSD controllers the fastest at that capacity, but it gives you plenty of wiggle room for your OS and most of your apps. Frankly, we think the best way to move everything over is just to do a fresh install, but if you want to keep your existing structure, you can. First move all your documents, movies, pictures, music, etc. to your backup drive—you want to get the total amount of used space on your C: drive as small as possible. Aim for less than half the capacity of your SSD. Next, defrag the drive. (Note: Once you put your partition onto an SSD, you should never defrag it, as this isn't good for the SSD.) Then, use a partition manager like Windows Disc Management to shrink your C: partition down to the size of your new SSD, and use Windows Backup to create a system image onto your backup drive. While you're at it, create a recovery disc using Windows Backup.

Install your SSD into your rig, then boot from the Windows recovery disc and restore from your system image to the SSD. You should be all set!

Upgrading to USB 3.0

I have a 2-year-old PC that has an Asus P6T mobo and a Cooler Master ATCS 840 case. If I upgrade my motherboard, and that upgrade includes USB 3.0, will the ATCS 840 front-panel connectors be able to use 3.0? Are they entirely dependent on the mobo's speed? Or do they need to be upgraded, too? (And if so, can you buy a front-panel connection for an ATCS 840?)

—Dave Ruppel

THE DOCTOR RESPONDS: Dave, USB 3.0 uses a different internal header than USB 2.0, so the ATCS's front-panel USB 2.0 ports won't be able to use the internal USB 3.0 header on the new motherboard. The bad news is that Cooler Master doesn't make a USB 3.0 upgrade cable for that case, but the good news is that you can get a 3.5-inch bay device with two USB 3.0 ports on an internal header for less than $20. That way you can keep your USB 2.0 ports and have a couple of front-panel USB 3.0 ports, as well. We used one from BioStar that cost us less than $20.

One Card, Three Monitors

I'm looking for a graphics card to run three monitors side by side. I'm a systems administrator. I don't play video games (I pretty much suck at 'em). I occasionally edit pics, run virtual machines, and frequently use over 50 percent of my RAM. I'm using a Dell Studio XPS with 12GB of DDR3, WD Raptors in RAID 0, a Silent Pro 800W PSU, and an Intel Core i7-975 Extreme.

I decided to add a third monitor, since I usually have a lot of windows open. I'm looking for a card that will increase my system performance instead of slowing it down. I tried using an Asus HD 6670. That was a fail. It made every single click slower. My computer runs like crap with this card and three monitors. That's what I get for trying to go cheap. What's the Best of the Best for this situation? If possible, I would like to keep it under $300.

—Steve Culpepper

↘ submit your questions to: doctor@maximumpc.com

THE DOCTOR RESPONDS: At that price range, we would go for an AMD Radeon HD 7850. It will support up to six monitors with AMD Eyefinity (although for that configuration, you'll need to use DisplayPort daisychaining). It's the best card you can get for under $300 that supports three monitors, unless you can find a Radeon HD 7870 on sale.

Core i7 Slowdown?

Doctor, I need help with my PC! It is running at 1.6GHz when it's supposed to be running at 3.4GHz. My CPU is a factory-overclocked Core i7-2600K. I've tried to fix it through my BIOS, but that didn't work. Help!

—Geva

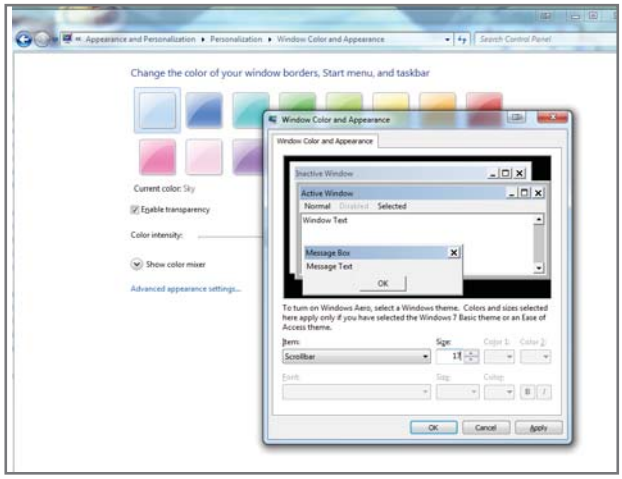
THE DOCTOR RESPONDS: Your CPU is designed to run at a lower clock speed when it's not being used. Download TMonitor from CPUID.com and run it. If you're not doing anything else with your computer, you should see that the clock speed is around 1.6GHz. But if you do something that actually utilizes the CPU (like run Prime95 or another benchmark), you'll see the clock speed go up to 3.4GHz on as many cores as you're using.

Relief for Sore Eyes

In Windows Vista and previous versions, I have always been able to adjust the width of the scroll bars. Many of the people I provide tech support to are baby boomers and they have a hard time using the scroll bars on the default setting. I used to be able to go through Display Options and set them manually to about 22 pixels. I would also adjust the size of the font up to 12 or 14 on the desktop icons and sometimes the icons themselves up as much as 44 pixels. I do this for them so they don't lose the resolution for watching movies and other media by changing the entire screen resolution. But now with Windows 7 I swear I just cannot find any way to do it. If I knew where to look in the Registry I would go in and change the default so users could not knock it out of whack if they go on an exploring expedition.

—Carl Smith

THE DOCTOR RESPONDS: Microsoft buried this option in Windows 7, but it's still there. Right-click the desktop and select Personalize, then Window Color, then hit Advanced Appearance Settings. This will open the Window Color and Appearance dialog. Under the Item drop-down menu, scroll to Scrollbar. You can then adjust the width of the scroll bar in pixels (the default is 17). To change the text size, go to Control Panel > Appearance and Personalization, and under Display select "Make text and other items larger or smaller." This will give you basic small/medium/large controls; to fine-tune settings, look in the left-hand menu for "Set custom text size (DPI)."



You can adjust the size of many Windows features in the Windows Color and Experience dialog.

SSD Alignment

Back in November 2011 I purchased a 64GB Crucial M4 SSD so I could use it as cache for my hard drive via Intel's Smart Response Technology. I took the SSD out of the box, updated the firmware and set it up through the Intel Rapid Storage Technology interface, and have been running with it ever since. I was wondering if I needed to have formatted/aligned the SSD before using it for caching? Have I been cutting my SSD's lifespan by not formatting/aligning it? Is formatting/aligning only particular to using it as a regular storage device or boot drive? There have been no problems with IRST. I have seen improvements in program response as well as faster boots and shutdowns.

—Joeseth Perez

THE DOCTOR RESPONDS: If you're just using it for caching, IRST (which handles SRT—why did Intel use such similar initialisms?) should handle all that stuff for you. Aligning is only an issue if you're using Windows XP, as Vista and 7 automatically align SSDs correctly, and if you're just using the drive for caching you don't need to worry about formatting, as SRT takes care of all that.

Upgrade, Then Sell?

I'm planning on building a new computer. My current computer has a liquid-cooled 3.2GHz quad-core Phenom, an Asus M4A88TD-M motherboard, a 1GB Radeon HD 5770 videocard, 16GB DDR3/1333, and a 1.5TB hard drive. Should I put in a new CPU (such as an FX-8150) and overclock that and the RAM before I sell it, or just sell as-is?

With the money, I plan on building a new PC with a Core i7-3820, a 3GB Radeon HD 7970 Black Edition, 32GB DDR3, a 256GB Samsung SSD, and an Asus Rampage Extreme motherboard. Or should I wait for Ivy Bridge-E to come out?

—Cody

THE DOCTOR RESPONDS: There's no point in spending money on a new CPU for a computer you're trying to sell. Let whomever buys it upgrade it if they want. And obviously you're going to have to supplement your earnings from selling your PC if you want to upgrade to a rig as fancy as the one you describe. As for whether to build now or wait for Ivy Bridge-E, well, PC hardware is always going to be faster and cheaper later. To help you make your decision though, a Sandy Bridge-E Core i7-3820 is a serious step over a Phenom II in compute-intensive tasks, so it will feel noticeably different. Rumors point to Ivy Bridge-E not making an appearance until early next year.

[SECOND OPINION]

I was just reading your response to Anderson Wu about swapping motherboards without reloading Windows ("Getting Ready for the Move," June 2012) and I thought I should chime in. StorageCraft makes a product called ShadowProtect Desktop Home ($90, www.storagecraft.com) that does a great job at image-based backups and has a little-known feature called Hardware Independent Restore. It actually strips the drivers away from the source backup image, allowing you to restore a working OS to completely new hardware.

—Eric Schueler

100 WAYS TO SPEED UP WINDOWS

YOUR TIME IS PRECIOUS. THAT'S WHY WE HATE TO SEE WINDOWS CONSUME MORE OF IT THAN NECESSARY. WHETHER YOUR OS HAS BECOME INCREASINGLY SLOW, OR YOU JUST SPEND TOO MUCH TIME DOING SIMPLE TASKS, THE FOLLOWING 100 TIPS AND TRICKS WILL GIVE YOUR PRODUCTIVITY A WELCOME KICK IN THE PANTS. BY JAMES STABLES

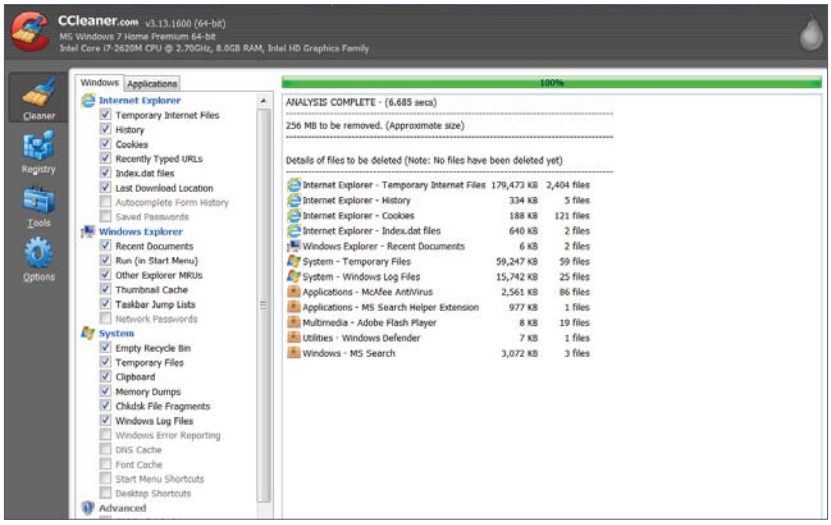
1 TRIM YOUR START-UP

One of the biggest causes of a PC slowing down over time is too many programs competing to start when the machine boots. For PC users, every step is plagued by people peddling their wares, regardless of the impact on the user experience, from manufacturers preloading trialware and bloated software to legitimate software makers who honestly believe their program should open as soon as your computer starts. The result is chaos and can slow your PC to a crawl, but fortunately, it's easy to trim things back.

In Windows 7 you can use Windows Defender to help stay on top of programs. Just go to the Start menu, type **msconfig**, and open the console. At the top you'll see a tab called Startup. Click it and you'll see all the programs that are scheduled to start when Windows does.

A lot of these are services for your PC, and eliminating them from startup doesn't always mean smoother running. For example, many PCs will have the HD Audio software start up automatically, which is pretty essential. However, as you scroll down the list, you'll start to see regular offenders.

If you've been suffering a slow boot, you'll know which programs are the most bloated, so uncheck these before pressing Apply. If you don't recognize a program, or its location doesn't show it to be in the Program Files, we recommend you just ignore it altogether.



2 CLEAN UP YOUR HARD DRIVE

Over time your PC will become clogged with unwanted files, and this will cause it to get slower. Just like a race car that's full of unwanted junk, clearing out the rubbish will make a huge difference.

The first thing you can do is go to Start > Accessories > System Tools and go to Disk Cleanup. This checks your PC for unwanted temporary files, which are left behind after programs are installed, as well as your Recycle Bin and other common clutter bugs. It will give an estimate of how much waste you can eliminate. Just click OK to begin the cleanup.

If your PC is really full, you might need a more powerful clutter cutter. CCleaner is a heavy-duty software uninstaller that goes a lot deeper than the system tools. It's available (for free!) at www.piriform.com. Install the program and enable the option to smartly detect cookies to keep. When the program opens, click the Analyze button to see how much clutter is present—you might be in for a surprise.

When you're ready, just click Run Cleaner and watch as CCleaner trims the fat from your computer, leaving it leaner and faster. Run the program every month and your PC will be less susceptible to slowing down over time. There are other free programs that can declutter your system. We've listed five that we like on page 28. They can make a real difference in the speed of your PC.

3 STREAMLINE YOUR PC

PCs take a lot of abuse, and folks who like to try new software will often leave lots of unwanted applications on their PCs. Removing these is a quick, easy fix that will speed up your PC.

To begin, click Start > Control Panel, then select Uninstall a Program. If you have Windows Vista or Windows 7, then right-click the Name column header, click More, and choose the details you'd like to see about each program. We recommend checking the Name, Size, Installed On, and Last Used On boxes.

Now choose to sort by Date Last Used, and you'll see your applications sorted by when they were last run.

If you have programs that haven't been used in months, then try getting rid of them, or switching to a free download that can be installed when and where you need it. Many programs are now available in the cloud. This means that there's next to no footprint on your PC, and the bulk of storage is contained online. There are cloud versions of Photoshop, Office Word, Excel, and OneNote, which offer stripped-down functionality.

You can also click "Turn Windows features on or off" or "Add/ Remove Windows Computers" to remove Windows applets you're not using, but this generally has less effect. If you never run an applet then it won't slow you down and turning a feature off won't free up much, if any, disk space, either.

4 SAVE TIME WITH AUTOHOTKEY

1 Install AutoHotKey

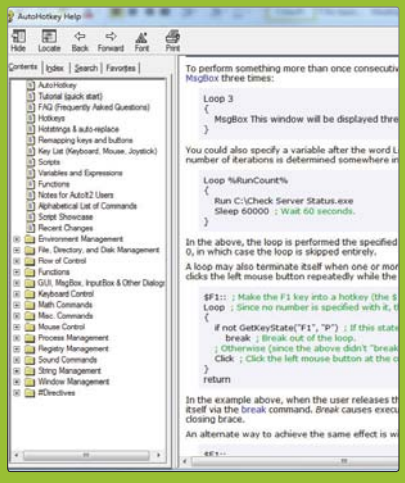
AutoHotKey (free, **www.autohotkey.com**) is a powerful tool for automating repetitive tasks. Download and install it, then right-click your Desktop or inside any folder and select New > AutoHotKey script. Right-click the resulting .ahk file to edit it. Hope you like plaintext!

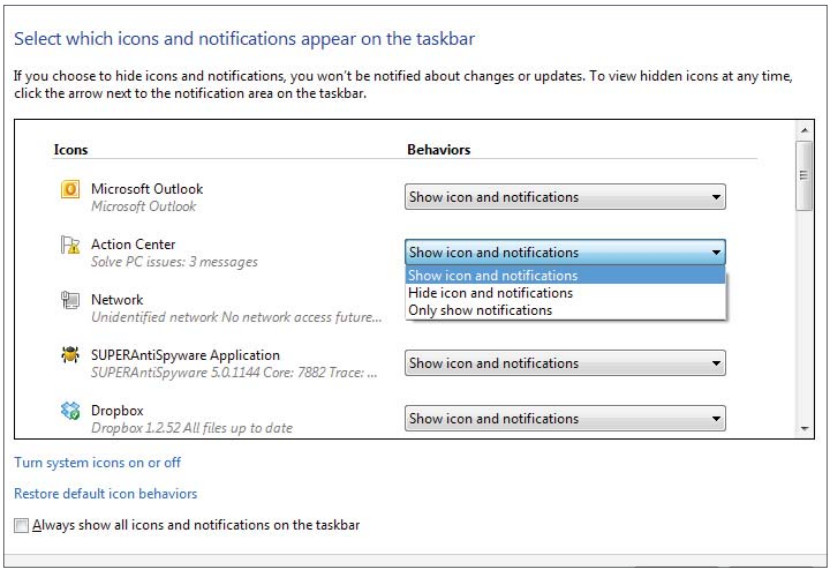
2 Read the Manual

AutoHotKey lets you create keyboard shortcuts, text expansion snippets, and macros, but it has a steep learning curve—fortunately a robust tutorial takes you from **#space::run www.maximumpc.com** (which sets Win + Space to launch MaximumPC.com in a browser window) to complex conditionals and macro recording.

3 Get Ambitious

AutoHotKey's scripting language is powerful—you can use text expansion to save you typing time, or do something as complex as using one button to screencap, import to Photoshop, crop, and save. It may take a while to script, but the results will save you lots of time. Check out *Maximum PC*'s 2010 How To for more! **bit.ly/LKgU1d**



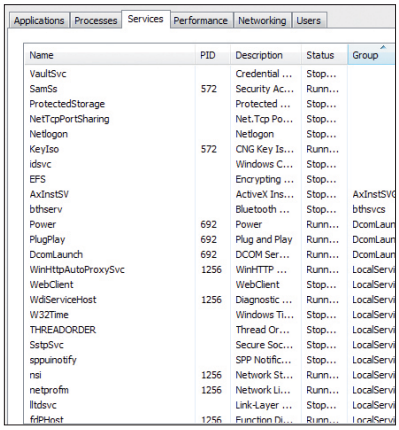


5 MANAGE YOUR SERVICES

Services are programs designed to work silently in the background on behalf of both Windows and some third-party applications. They're loaded before the Welcome screen appears and run regardless of which user is logged on.

Services cover a wide range of uses and, depending on your computer, not all will be needed. For example, the Windows Update service is essential because it monitors and downloads updates for Windows, but the Bluetooth Support service is only relevant if you have a Bluetooth adaptor installed in your PC.

Having these services running can be a real drain on your PC's performance, but with some nifty tools you can get them under control. One such tool is SMART (bit.ly/dosSJj), which takes a lot of the risk out of canceling services by telling you which ones are safe to stop.



6 TAKE CONTROL OF YOUR SYSTEM TRAY

Perhaps you've wondered about that odd assortment of icons that lives at the far right of your taskbar, in the area commonly known as the system tray or notification area. It's a visual cue of what programs are running in the background, with the notifications letting you know about changes or updates to a program. You can take full control of the system tray so that it contains the information that's most useful to you, thus increasing your efficiency.

To customize the system tray, right-click the taskbar, select Properties, and then click the Customize button in the middle of the screen. Now, for each program decide how and when you want the icon and notifications to be displayed. You can also rearrange which icons appear on the taskbar itself and which ones are only visible when you click the system tray arrow. Just drag and drop to your liking.

7 ENABLE PREVIEW PANE

You can save a lot of time by enabling the preview pane in Windows Explorer. It lets you see the contents of any file without having to actually open the file. Open Windows Explorer (explorer.exe), select Organize, and then Layout. Select Preview pane from the menu. Now, when you click on any file in Explorer you will instantly see its contents in the preview area to the right. You can adjust the size of the preview area by dragging its left-hand border.

TASKBAR SPEED-UP TIPS

When it comes to saving time, the taskbar is a very powerful tool

8 LAUNCH APPS FAST

To select a taskbar app from the keyboard, hold the Windows key and press one of the numbers across the top of your keyboard. Press 1 to launch the first icon, 2 for the second, 3 for the third, and so on up to 0 (that represents 10), so you can have items open in seconds.

9 FAST TASK-SWITCHING

To quickly switch between windows of the same application, hold down the Ctrl key as you click the app's taskbar icon. This is great for when you have multiple instances of Internet Explorer with different websites, or when you're working with photos and images.

10 KEYBOARD SPEEDUP #2

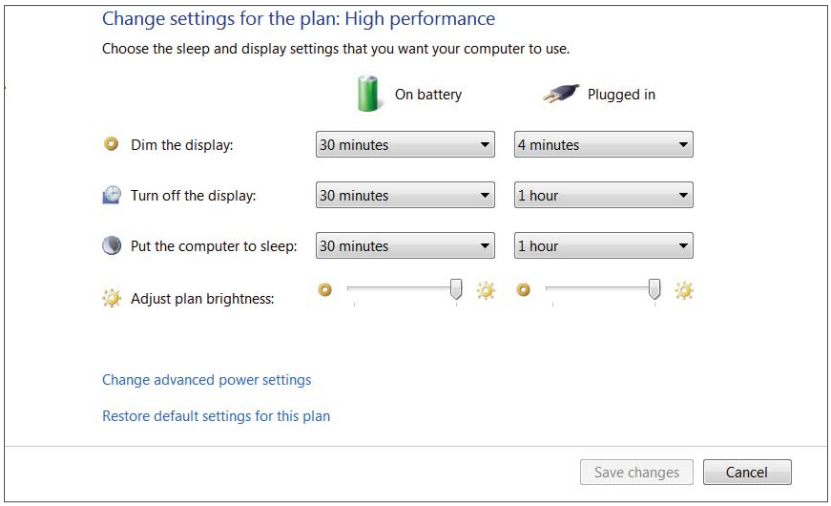
To switch to a taskbar application from the keyboard, hold down the Windows key and press T to select the taskbar, then use the left and right arrows to select an application and the Return key to launch it. This can be easier than remembering numbers.

11 RELAUNCH WITH A CLICK

If you've launched an application and then want to run another copy, don't go back to the Start menu—just hold down Shift, click the app's taskbar icon and Windows fires up another instance of the program. Again, this works especially well for browsing.

12 GET A PREVIEW

If you work with multiple windows, such as several tabs in IE, finding them can be a drag. In Windows 7, just click the program icon on the taskbar to get live preview windows of every tab or window. This makes it easy to go straight to where you need to be.



13 HALT RUNAWAY PROGRAMS

If a buggy program is grabbing all your processor time, slowing everything else down, and you can't close it, press Ctrl + Shift + Esc to launch Task Manager. Click Processes, then select "Show processes from all users." Click the CPU column header and find the program using the most CPU time. Right-click the program, select Set Affinity, clear all but one of your processor core boxes to limit how much of your system resources it can use. Your PC will speed up.

14 CUSTOMIZE THE POWER BUTTON

If you find that you typically restart your PC more often than you shut down, you can save yourself the cumulative nanoseconds incurred every time you have to select Restart by making that the default button option. Right-click Start, choose Properties, and under the Start Menu tab, select the power button action that you use most frequently.

15 VISUALIZE YOUR STORAGE SITUATION

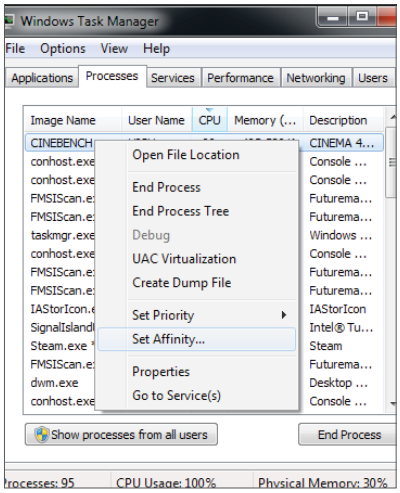
There's no better way to see what you're storing on your hard drive and whether it's earning its keep than by using a visualizer. One of our favorites is WinDirStat (free, www.windirstat.info). On startup it creates a rectangular treemap of all your folders and files, color-coded by file type. With the graphical evidence before you, you can easily determine what stays and what goes.

16 USE HIGH-PERFORMANCE MODE

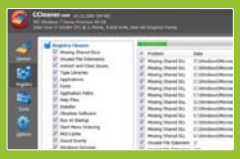
The Windows 7 Power Options can make a real difference to system speed. Go to Control Panel > Hardware and Sound > Power Options, and ensure you have High Performance selected. Alternatively, if your computer is being too demanding on your laptop's battery, then you can go into a low power mode, but this will slow Windows down.

17 SET YOUR PC TO BOOT WITH GREATER SPEED

If you've installed multiple versions of Windows on your computer, you'll get a menu asking which version you'd like to launch. By default this waits up to 30 seconds before selecting the default choice, but if that's too long, launch msconfig from the Start menu, click the Boot tab, and set the Timeout figure to, say, 10 seconds instead.



FIVE PROGRAMS FOR KEEPING YOUR PC SPEEDY

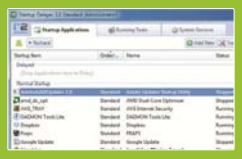


18 CCleaner

We mentioned the awesome cleaning power of CCleaner (see tip #2), but it has other powers, too. Try using the Registry Cleaner, which spring cleans the back end of Windows for faster performance. bit.ly/8XAvD9

19 Glary Utilities

Another piece of cleaning software that gets rid of leftover files, Glary can also securely uninstall programs, which is a notoriously messy experience when done in Windows. www.glarysoft.com



20 Startup Delayer

This free program will stagger your startup apps, which stops Windows from grinding to a halt. To learn more about how to put Startup Delayer to use, see our How To on page 56. www.r2.com.au

21 Foxit Reader

If you regularly read PDFs, you probably get frustrated by Adobe Reader's lumbering lack of speed. Foxit Reader speeds things up, making viewing PDFs quick and easy. It also uses very little of your computer's memory. bit.ly/KvjPZb

22 Everything

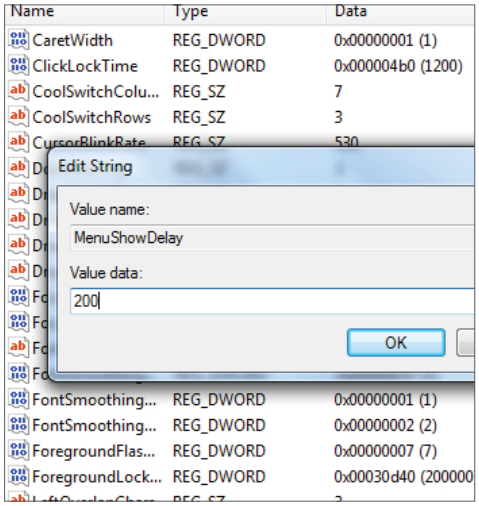
Windows' native search functionality has improved greatly over the years, but if you want a truly speedy search of your PC's contents, you need the free file-indexing app Everything. www.voidtools.com

23 DELETE DUPLICATE MUSIC IN ITUNES

It's an unfortunate fact about iTunes on Windows that it will sometimes store duplicate tracks of the same song.

Luckily, iTunes includes a tool that finds, identifies, and removes duplicates, keeping your music collection trim and, more importantly, your computer lean.

In iTunes, go to File > Display Exact Duplicates and a list of all repeated songs will be displayed. It would be a lot easier if iTunes only showed the duplicate ones, but unfortunately it displays both, so you'll have to tick the second version and hit Delete.

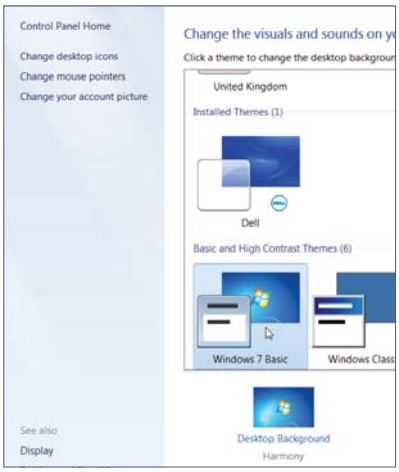


24 REMOVE OLD PICTURES

When you edit a photograph in Windows Live Photo Gallery, it keeps a copy of the original forever. That's great if you've actually made the new pic look awful or want to keep the original, but otherwise it's a waste of space. To tweak this, launch Photo Gallery, click File > Options > Originals, and under "Move originals to Recycle Bin after" select one month—or longer if you prefer.

25 SAVE RESOURCES

If you've installed an antivirus package, it's a waste of resources to have Windows Defender running as well, since you essentially have two programs doing the same tasks. To turn off Defender, click Start, type **Defender** and click Windows Defender to fire up the program. Click Tools > Options > Administrator, clear the Use This Program box, and then click Save.



26 SPOT HIDDEN WINDOWS

Sometimes programs display a message asking you to do something, but that message is under another window and you don't see it. You're waiting for the program, it's waiting for you, so nothing happens. The window is made visible after 200 seconds, but you can shorten the delay. Launch regedit from the Start menu, go to HKEY_CURRENT_USER\Control Panel\Desktop, double-click ForegroundLockTimeout and select Decimal. Change the value to 30,000 milliseconds (30 seconds) and see how this works.

27 SAVE A REGISTRY KEY

Sometimes a change to a registry key doesn't go as planned. It's quick and easy to return to the key you changed if you've saved it to Regedit's Favorites menu. It's at the top of Regedit's editing window. Click Add to Favorites, give it a descriptive name, and tweak away knowing that changes can be undone in seconds.

28 DISABLE AERO

If you're running Windows 7 on an underpowered computer, improve performance a little by turning off the Aero interface. Right-click an empty part of the desktop, select Personalize, scroll to Basic and High Contrast Themes and click Windows 7 Basic. If you miss the old look, return to the Personalize dialog and choose an Aero Theme.

Alternately, you can disable Aero for just a particular program—say, something that could use a little extra RAM. Browse to the program's executable file or its shortcut, right-click it, select Properties > Compatibility and check "Disable desktop composition." Run the program and Aero is turned off. It's restored when the program is shut down.

USE WINDOWS FASTER

Windows offers many tricks to help you work more efficiently

29 Instant PC Folder

Hold down the Windows key, press R to launch the Run box, type **.** and hit Return.

30 Access Your Users Folder

Launch the Run box, type **..** and press Return to launch the Users folder.

31 Access the Shell

To open your Startup folder, for example, click Start, type **shell:startup** and press Return.

32 Faster Searching

When you want to search for something in an Explorer window, just press F3.

33 See Recent Folders

Press F4 and you can choose recent folders from the History list much more quickly.

34 Refresh Now

If an Explorer window seems to be missing a file, folder, or drive, hit F5 to refresh the window.

35 Full-screen View

If you're examining an enormous list press F11 to toggle full-screen view.

36 Open a Folder Tree

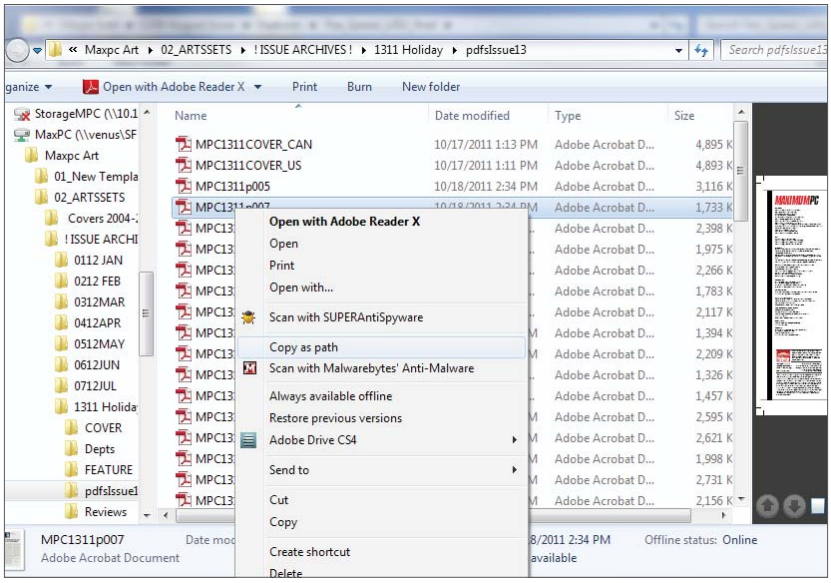
Press + on the numeric keypad to expand the currently selected folder.

37 Expand All Folders

Pressing * on the numeric keypad expands all folders below the current one.

38 Collapse all Folders

Press - on the numeric keypad to collapse the current folder.



39 COPY AS PATH

If you've ever found yourself hunting down a file in Explorer that you want to upload online only to have to retrace your steps once you've opened your browser, you need to know about Copy as Path. When you first locate the file in question, press Shift while right-clicking and choose the Copy as Path option. Now the location of your file is saved to the clipboard for easy deployment in your browser dialog.

40 BROWSE MENUS AT SPEED

A registry edit can shorten the pause before Windows menus expand, speeding up navigation. Launch regedit from the Start menu, go to HKEY_CURRENT_USER\Control Panel\Desktop, double-click MenuShowDelay, and select Decimal. Change the default—200, which is 0.2 seconds, works for us. The result is a noticeably more instant browsing experience, which is highly addictive. Once you've enjoyed Windows opening like lightning, going back to the normal setting will feel like watching a slow-motion replay.

41 SOLVE SLOW STARTS

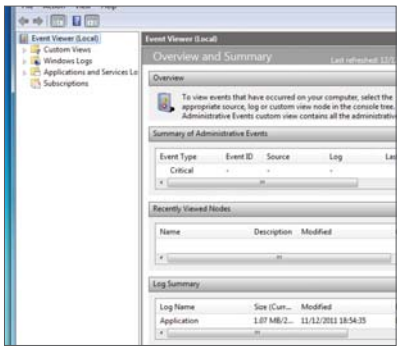
If Windows 7 is taking a long time to launch, or shut down, the Event Viewer may tell you which program or driver is responsible. Click Start, type **Eventvwr.msc**, and press Return. Expand the Applications and Services Logs section and browse to Microsoft\Windows\Diagnostic Performance\Operational. Scroll the events list on your PC to see if Windows knows who to blame for your performance issues.

42 FIX THE BOOT BUG

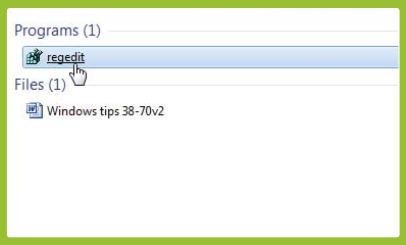
Is your Windows 7 desktop background a solid color? Then it may mean your PC takes 30 seconds longer than usual to boot. One solution is to change your background to an image, which will restore normal startup performance and make your desktop look better, as well. But if you're set on solid colors, then install a hotfix from Microsoft (support.microsoft.com/kb/977346) that will return your system to normal.

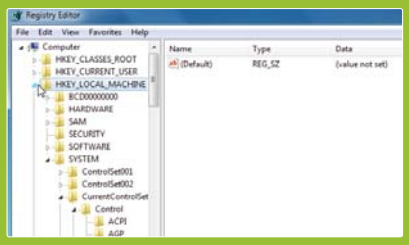
43 SEARCH THE WEB FROM YOUR START MENU

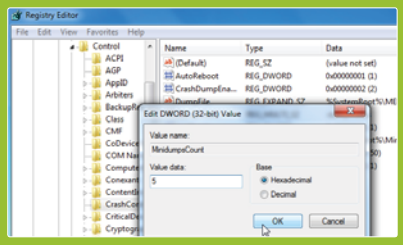
Windows 7 Professional and Ultimate users are able to set up the Start Search option to search the web. In Start Search type **gpedit** and open the app. Then navigate to User Configuration > Administrative Templates > Start Menu and Taskbar. Then double-click "Add Search Internet link to Start Menu." When you type a search into the Start menu, there will be the option to make it a web search, so you can more quickly get the information you need.



44 SAVE SPACE BY DUMPING CRASH DATA







1 Run regedit

Windows 7 keeps files on your last 50 crashes. However, if you'll never look at this data it's a waste of hard drive space, so you're better off getting rid of it. Type **regedit** into the Start menu and launch the executable.

2 Make the change

Browse to HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\CrashControl. Double-click the entry called MiniDumpsCount and change the Value data according to how many crash files you want saved—five is enough.

3 Enjoy a faster machine

When you restart your PC, you'll have reclaimed some free space on your hard drive, which is useful for both older machines with small hard drives or newer SSD laptops, which have equally tiny disks.

45 RESTORE RUN

If you miss the Windows XP Run option, which was used by many to launch programs quickly, right-click the Start orb, select Properties > Customize, check the Run Command box, click OK, and a Run option now appears on the Start menu. Many of our tips feature the Run command and if you love sneaky shortcuts, this is a very easy way to start using Windows more quickly.

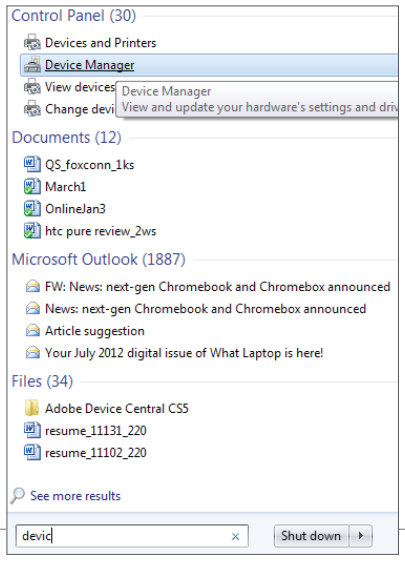
46 LAUNCH APPLETS FAST

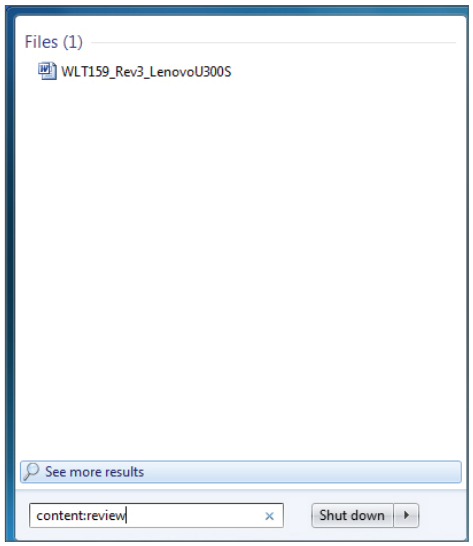
Don't waste time browsing to the Control Panel for the right tool for making changes to your computer when you can launch it directly. To run Device Manager, for example, click Start, type **Device** in the search box and Windows should display a Device Manager link for you. Windows also responds to vague searches, so if you type **partition**, the disk management tool will be listed.

You can also type the applet's executable file name, such as: **devmgmt.msc** (Device Manager), **services.msc** (Services), **dfrg.msc** (Disk Defragmenter), **compmgmt.msc** (Computer Management), **diskmgmt.msc** (Disk Management), and **compmgmt.msc** (Computer Management Console).

47 OPEN WEBSITES WITH A KEYPRESS

In Internet Explorer, click Favorites, right-click a particular Favorite site, and select Properties. In the Shortcut Key box, press the key combination you'd like to launch the site—Ctrl + Alt + G for Google, say. Close your browser, press your shortcut key, and your default browser opens to display the site. This also works for any Windows programs.





48 ACCESS NETWORK FILES FASTER

To work on network files even when your PC isn't connected (in Windows 7 Professional, Ultimate, or Enterprise) there's an easy fix. When the network computer is available, browse to the file or folder you need, right-click it, select Always Available Offline so that it's checked and Windows makes a local copy available for you.

49 FIND THE RIGHT FILE

If you occasionally need to search the contents of files that haven't been indexed, just start your search with **content:**. This will tell Windows to go looking inside your files for the right information, even if Windows Search hasn't gone through and done it already. As this happens only a couple of times a day, new files might not be indexed, so it's well worth doing. Typing **content:zebra** into any search box locates files that have "zebra" in their contents, for instance.

50 SAVE TIME ON SWAPPING PRINTERS

To have Windows switch your default printer as you change networks, click Start, type **Devices**, and click Devices and Printers. Choose a printer and click Manage Default Printers. Select "Change my default printer when I change networks," choose a network and a default printer, and click Add. Repeat for other networks and pick a default printer. Now when you connect to a network, Windows will set a defined printer.

51-71 WINDOWS KEY SHORTCUTS

The Windows key has many uses. Here are just a few...

Windows + Left Arrow
Dock the current window left

Windows + Right Arrow
Dock the current window right

Windows + Up Arrow
Maximize the current window

Windows + Down Arrow
Minimize the current window

Windows + M
Minimize all windows

Windows + Shift + M
Maximize windows

Windows + Space
Make all windows transparent

Windows + L
Lock your desktop

Windows + B
Move the focus to system tray

Windows + E
Launch My Computer tray

Windows + F
Open the Find dialog

Windows + Ctrl + F
Open the Find Computer dialog

Windows + Pause
Display System Properties

Windows + [+]
Zoom in on the screen

Windows + [-]
Zoom out from the screen

Windows + U
Open Ease of Access Center

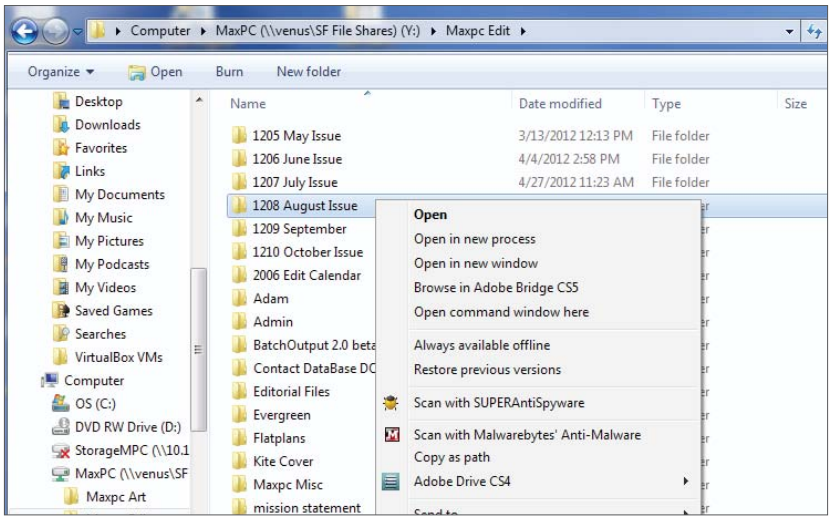
Windows + T
Cycle through taskbar items

Windows + Tab
Cycle through open windows

Windows + R
Open the Run command

Windows + L
Lock your Windows PC

Windows + F1
Open the Help folder



72 SPEED UP START MENU SEARCHES

Right-click the Start button and select Properties. Click Customize, scroll down the list of available options, and select "Search without public folders" under "Search other files and libraries." Click OK and results should appear much quicker than before, as there are far fewer places to search. Public folders are rarely used by most people, so axing them in search is a cost-free speed up trick.

73 LOAD WEBSITES MORE QUICKLY

By changing your DNS server to OpenDNS, you're able to browse the Internet more quickly and safely. Visit www.opendns.com/start to sign up for a free basic plan.

74 SCALE BACK VISUAL EFFECTS

If you don't have a lot of memory installed (1GB in Windows 7 or Windows Vista, or 256MB in Windows XP), click Start, right-click Computer or My Computer, and select Properties. Select "Advanced system settings" (Advanced tab in Windows XP) and under Performance click Settings. Select "Adjust for best performance" and click OK to give yourself a speed boost.

75 QUICKLY ACCESS THE COMMAND PROMPT

Did you know that you can open the command prompt from any folder? Press the Shift key while right-clicking the folder and then choose the option to "Open command window here." This trick also works on the desktop.

76 GIVE YOUR PC A HELPING HAND

If you have a spare USB flash drive, you may be able to use it to give your PC a small boost. Plug the drive in and—if prompted—choose "Speed up my system." Otherwise, click Start > Computer, right-click your flash drive and choose Properties, then choose "Use this device to enable ReadyBoost." Mind you, this likely won't improve performance on a 64-bit install of Windows, but if you're rocking a 32-bit version of the OS you should check it out.

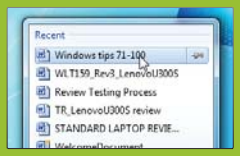
77 MAKE YOUR PC AS GOOD AS NEW

Get that shop-fresh feeling back by re-installing Windows using the disc that came with your PC. When you're done, go to Start > Search, type **Back up and Restore** and set a restore point, so you can roll back to this clean setup in the future, bypassing the installation process.

78 MANAGE YOUR FONTS

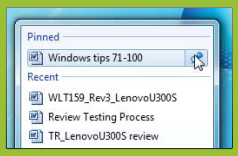
Over time, the number of fonts installed on your PC swells and each one uses up precious system resources. Use a program such as AMP Font Viewer (www.ampsoft.net) to remove those fonts you never use. Windows Vista and Windows 7 users should right-click the program shortcut, choose Properties > Compatibility and tick "Run this program as an administrator" for it to run properly.

FIVE WAYS JUMP LISTS CAN SAVE YOU TIME



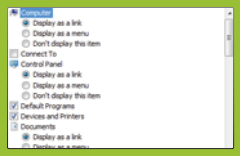
79 Launch Items

To open a Jump List, simply right-click a program icon on your taskbar to see a list of recently opened files associated with that application. It's quicker to launch a file from here than from the file's location.



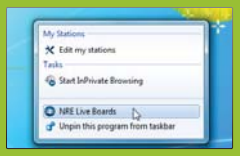
80 Pin Items

Only the 10 most recent items are shown, but you can "pin" your favorite items to a Jump List so they're shown permanently. Click the pin to have them locked and click it again to unpin.



81 Get in Control

You can add more recent items by right-clicking the taskbar, selecting Properties, and then going to the Start menu tab. At the bottom you can adjust the number of recent items to display.



82 Pin Sites

You can pin the websites you browse regularly to the taskbar, enabling you to launch them quickly. In your browser, just click the icon next to the URL and drag it down to the taskbar to add it.

83 Get More

If you use Internet Explorer 9, some websites have added functionality and are quicker to use when pinned. Try dragging Twitter or Facebook to the taskbar from Internet Explorer 9, and you'll see the difference.

84 CHECK DEFRAG

One of the oldest tricks for speeding up a PC's performance is hard drive defragmentation. Applicable only to mechanical drives (as opposed to SSDs), defragging takes all the various fragments of data that get scattered across hard disks over time and puts them in nice order so the drive doesn't have to work as hard at data retrieval. With Vista and Win7, defrags should happen automatically. To ensure that defragmentation is enabled on your hard drive (and not enabled on your SSD), right-click your drive's icon in Explorer, select Properties, then Tools, and click the Defragment Now button. Besides verifying the defrag status, you can select a schedule that will have the least impact on your computing activities.

85 TWEAK LIBRARY SETTINGS

Edit an existing Library or create a new one by clicking Start > Computer followed by Libraries in the Navigation pane. Click New Library or right-click an existing Library and choose Properties to include new folders in the library or remove existing ones.

86 SET UP YOUR FAVORITE FOLDERS

If you want even quicker access to specific folders—again from any folder window or when choosing Open or Save in a program—just browse to the drive or directory containing your target folder, then click and drag it into place on the Navigation pane under Favorites.

87 ADD PROGRAMS TO FAVORITES LIST

It's also possible to add programs to Explorer's Favorites list, although the process is a bit different. Open Windows Explorer and type C:\Users\[user name]\Links in the address bar (replacing [user name] with your user account name). Now drag and drop program shortcuts from the Start menu, desktop, or other location into the Links folder. Those program links will now appear in your Favorites list.

88 USE THE 'SEND TO' FOLDER

There are a number of useful shortcuts available to any file or folder, simply by right-clicking it and choosing Send To. You can open a file in a specific program, compress it into a zipped folder in order to save space, and create desktop shortcuts. And that's just for starters.

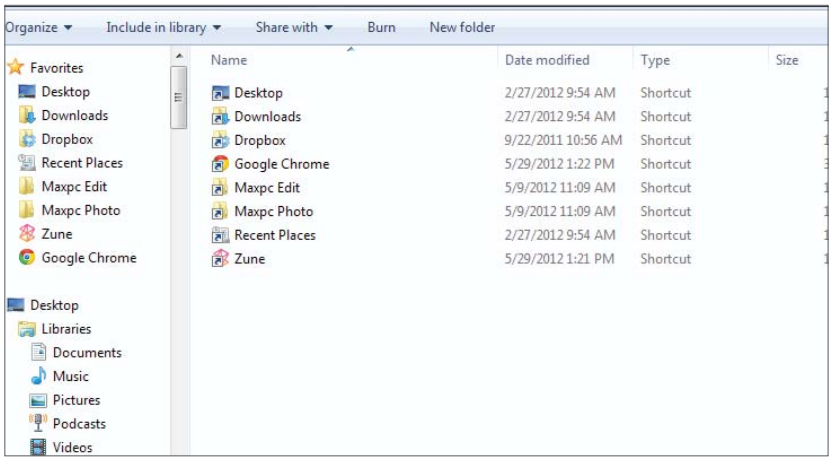
89 INVERT SELECTION

If you need to select a large group of nonconsecutive files within a folder, it's quicker to select the files you don't need before choosing Edit > Invert Selection. If you can't find this at first, don't worry—the Edit menu is hidden by default in Windows 7 and Windows Vista. Choose Organize > Folder and Search Options > View, then tick "Always show menus" and click OK to show it.

90 SPEED UP INTERNET EXPLORER

If Internet Explorer takes an age to open, select Tools > Internet Options > Programs. Click "Manage add-ons" and view the Load Times for each add-on (you may need to scroll to the right to view this). Add-ons cause Internet Explorer to run more slowly, so have a go at disabling sluggish add-ons unless they're important, such as those linked to your security program.

This isn't a problem that's confined to Internet Explorer. Firefox is renowned for its array of add-ons. If you've added applets that you're not using, slash them and enjoy the feeling of a more responsive browser.



INTERNET EXPLORER SPEED-UP TIPS

Make Windows' web services work faster for you, too

91 Alt + D

Selects the text in the Address bar

92 F4

Displays a list of addresses you have typed

93 Ctrl + Left Arrow

When in the Address bar, move the cursor left to the next logical break in the address (period or slash)

94 CTRL + RIGHT ARROW

When in the Address bar, move the cursor right to the next logical break in the address (period or slash)

95 CTRL + ENTER

Add www. to the beginning and .com to the end of the text typed in the Address bar

96 CTRL + SHIFT+ DEL

Delete browsing history.

97 CTRL + SHIFT + P

Open an InPrivate Browsing window

98 CTRL + T

Open a new tab

99 CTRL + 1-9

Switch to a specific tab number

100 ALT + HOME

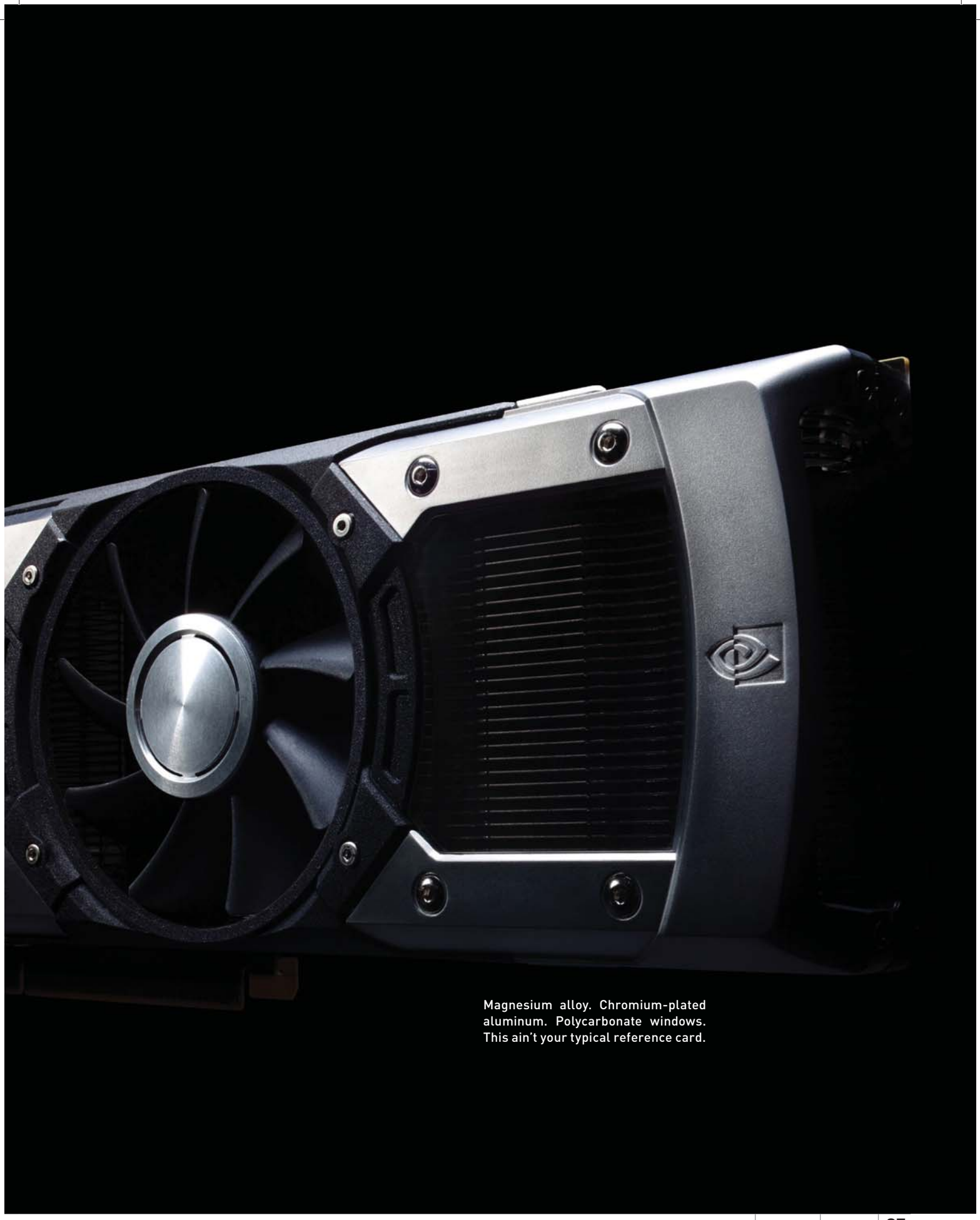
Return to your home page

BY NATHAN EDWARDS

DUAL OF THE FATES

IS NVIDIA'S GTX 690 A DUAL-GPU CARD WORTH BUYING?

IT'S BIG. It's beautiful. It costs one thousand dollars. Nvidia took two of its fastest Kepler GPUs and put them on the same dual-slot videocard. The resulting behemoth, dubbed the GTX 690, begs for attention. But the last generation of AMD and Nvidia dual-GPU cards was hot, loud, and disappointing. Does the GTX 690 carry on that ignoble tradition, or is it as good as it looks?



Magnesium alloy. Chromium-plated aluminum. Polycarbonate windows. This ain't your typical reference card.

> IT'S CLEAR THAT NVIDIA SPENT SERIOUS TIME WORKING ON THE REFERENCE SHROUD

Getting the Outside Right

The graphics card goes inside your computer and makes the stuff that comes out of your computer look good. It doesn't matter what the graphics card looks like on the outside (so long as it has, say, heatsinks and a fan shroud), just how powerful it is on the inside, and Nvidia and AMD's reference cards are usually reflections of this boring truism. In the battle for differentiation, though, third-party card vendors go to town, with custom fan shrouds and cooling systems that alternate between garish and gorgeous.

It'd be hard for any aftermarket vendor to improve on Nvidia's GTX 690 reference design, however. It's not just the prettiest reference card we've ever seen; it may be the most beautiful videocard we've seen, period.

The GTX 690 is a dual-GPU graphics card that's 11 inches long—big for an Nvidia card, but far smaller than the 12.2-inch

SPECIFICATIONS

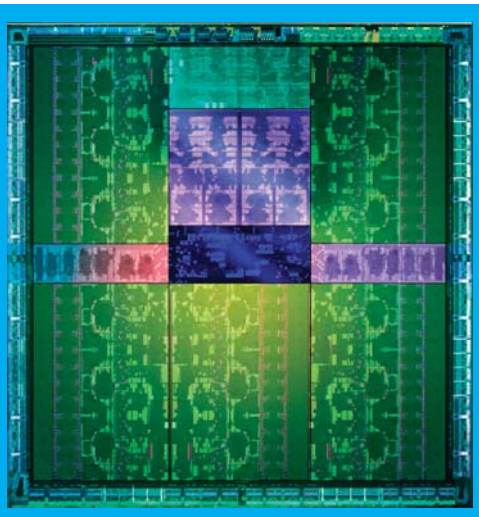
	GeForce GTX 690	GeForce GTX 680	Radeon HD 7970	GeForce GTX 590
Number of Cores	3,072*	1,536*	2,048*	1,024*
Texture Units	256	128	128	128
ROPs	64	32	32	96
Base Clock Frequency	915MHz	1,006MHz	1,000MHz	607MHz
Boost Clock Frequency	1,019MHz	1,058MHz	N/A	N/A
Memory Clock Frequency	1,502MHz actual	1,502MHz actual	1,375MHz	854MHz
L2 Cache Size	1,024KB (512KB per GPU)	512KB	768KB	1,536KB (768KB per GPU)
Frame Buffer Size	4,096MB (2,048MB per GPU)	2,048MB	3,072MB	3,072MB (1,536MB per GPU)
Memory Interface	2x 256-bit	256-bit	384-bit	2x 384-bit
Memory Data Rate	6Gb/s	6Gb/s	5.5Gb/s	3.4Gb/s
Manufacturing Process	28nm	28nm	28nm	40nm
Transistor Count	7.08 billion	3.5 billion	4.3 billion	3 billion
Connectors	3x dual-link DVI, 1x Mini DisplayPort 1.2	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)	3x dual-link DVI, 1x Mini DisplayPort 1.1a
Power Connectors	2x 8-pin	2x 6-pin	1x 6-pin, 1x 8-pin	2x 8-pin
Thermal Design Power (TDP)	300W	195W	250W	365W

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

WHITHER BIG KEPLER?

The GPU in the GTX 680 and 690 is designated GK104, and the "104"-designated GPUs aren't usually the biggest, most powerful of their generation. The Fermi GF104, for example, powered the GeForce GTX 460, a midrange card, while the later GF110 (a smaller, more power-efficient version of the GF100) is the GPU in the GTX 580. So where's the GK110, and what sort of videocards will it power?

Nvidia dropped some info on the GK110 at this year's GPU Technology Conference. What do we know? Well, it's not for us. Yet. The GK110 will first appear in the Tesla K20, an enterprise-level card focused on GPU computing, not graphics. It contains a whopping 7.1 billion transistors—double that of the GK104—and will have up to 2,880 CUDA cores. The GK104 has 1,536. The GK110 will also support Dynamic Parallelism and Hyper-Q, two technologies that make it very attractive for GPU computing but won't be relevant to gamers. The Tesla K20 is coming in Q4 2012, so we'd expect a consumer videocard based on the GK110 sometime after that, if at all. Don't hold your breath.



Nvidia released this GK110 die shot in May.

high water mark established by the AMD Radeon HD 5970 a few generations ago. It takes up the usual two PCI expansion slots. It requires one x16 PCIe slot, two 8-pin power connectors, and is fully PCIe 3.0 compliant. The rear of the card contains three dual-link DVI ports and a DisplayPort 1.2 port, and the GTX 690 can actually drive four monitors at once.

Rather than the usual black plastic, Nvidia has wrapped the GTX 690 in chromium-plated cast aluminum, with an injection-molded magnesium-alloy fan housing. Polycarbonate windows cover the vapor chambers over each GPU while keeping the cooling channels visible. The "GeForce GTX" logo on the side even lights up. Our one complaint about the GTX 690's externals is the same one we had about the GTX 590: The center-mounted fan blows hot air toward both the front and the back of the videocard, working against the normal front-to-back airflow of a typical cooling setup.

It's clear that Nvidia spent serious time working on this reference shroud, and it looks amazing. But looks aren't the reason to buy a graphics card: Nvidia says the precision-machined aluminum and metal cut down on vibration and fan noise. All that's very cool, of course, but you can't judge a videocard by its cover—or by the nice things its manufacturer says about it.

The Inside Scoop

The GTX 690 contains two of Nvidia's premiere Kepler GK104 GPUs—the same GPU as in the top-tier GTX 680 single-GPU card. We've discussed the Kepler architecture at length, most prominently in our June 2012 feature article ("Nvidia's Kepler: Overcoming the Sins of Fermi"), so we'll refrain from discussing the basic architecture, but it's Nvidia's fastest, coolest, most power-efficient top-end GPU to date.

The GTX 690's two GK104 GPUs sit on each side of the center-mounted fan and are connected to each other and to the motherboard via a 48-lane PLX bridge chip. Each chip is a full GK104: 1,536 CUDA cores, 128 texture units, 64 ROPs, and 2GB of 256-bit GDDR5, for a total of 3,072 CUDA cores, 256 texture units, 128 ROPs, and 4GB 6,008MHz GDDR5 across the card. The whole package has a TDP of 300W, compared to 195W for a single GTX 680.

Where previous dual-GPU cards, like the GTX 295 and 590, had substantially underclocked GPUs to meet the board's thermal and power limitations, the GPUs on the GTX 690 are only slightly underclocked: 915MHz with a 985MHz GPU boost clock, compared to the 1,006MHz base and 1,058MHz boost clock of a reference GTX 680. Nvidia has built in substantial

BENCHMARK

	Nvidia GTX 690	Nvidia GTX 680 SLI	AMD Radeon HD 7970 CrossFireX	Asus GTX 590
Price	$1000	$1,000	$960	N/A
3DMark 11 Performance	P15104	**P15804**	P13817	P9843
3DMark 11 Extreme	X5800	**X6072**	X5352	X3300
3DMark Vantage Performance	P44501	**P45205**	P44180	P36250
Unigine Heaven 2.5 (fps)	59.8	**60.8**	57.6	35.9
Shogun 2 (fps)	37.9	38	**75**	31.6
Far Cry 2 / Long (fps)	184.7	**187.9**	186.3	129.3
Dirt 3 (fps)	122.9	**124.5**	114.5	73
HAWX 2 (fps)	224	225	**229**	178
Metro 2033 (fps)	**29.6**	29.5	29	24
STALKER: CoP DX11(fps)	64.6	66.1	**76.7**	42.3
Just Cause 2 (fps)	79.31	81.03	**91.85**	54.91
Batman: Arkham City (fps)	102	**104**	86	68
Base Clock (Actual)	915MHz	1,006MHz	1,000MHz	608MHz
Boost Clock	985MHz	1,056MHz	N/A	N/A
Memory Clock	1,502MHz	1,502MHz	1,425MHz	854MHz
System Power @ idle (W)	**101**	110	102	105
Max System Power @ full throttle (W)	**567**	813	815	613

Best scores bolded. Our GPU test bed consists of a stock-clocked Intel Core i7-3960X on an Asus P9X79 Deluxe board with 16GB DDR3/1600, a 256GB Samsung 830 Series boot SSD, and a 1050W Thermaltake Toughpower Grand PSU, in a Cosmos II chassis. All tests performed at 2560x1600 with all settings maxed and 4x MSAA except where noted. Power use measured with a Watts Up Pro.

room for overclocking, too, and proclaims 1,100MHz-plus boost clocks from the stock configuration. Regardless, Nvidia says a stock-clocked GTX 690 will perform to within a few percentage points of SLI'd GTX 680s.

Performance Double

We tested the reference GTX 690 against two-card setups of the fastest single-GPU reference cards on the market: two GTX 680s in SLI, and two Radeon HD 7970s in CrossFireX. To see how far we've come, we also tested an Asus GTX 590—Nvidia's last-generation dual-Fermi card. We tested each configuration on the same test bed: a stock-clocked Intel Core i7-3960X on an Asus P9X79 Deluxe board with 16GB DDR3/1600, a 256GB Samsung 830 Series boot SSD, and a 1050W Thermaltake Toughpower Grand PSU, in a Cosmos II chassis. We ran every test on 64-bit Windows 7 Professional SP1 using the latest drivers available for each card at the time of testing. We ran all the gaming benchmarks at 2560x1600 resolution with all settings maxed and antialiasing set to 4x MSAA where available. PhysX was turned off in games that used it.

If the GTX 690 is one thing, it's fast. If it's two things, it's fast and consistent. In every benchmark, the GTX 690 is just slightly slower than two stock-clocked GTX 680s in SLI—on the order of one or two frames per second at 2560x1600. The Kepler setups perform better, by a little, than the CrossFireX'd Radeon HD 7970 reference cards in Unigine Heaven 2.5, Far Cry 2, and Metro 2033, and by a wider margin in Dirt 3 and Batman: Arkham Asylum. The Radeons push out decent wins in Just Cause 2 and Stalker, with a large advantage in Total War: Shogun 2.

The GTX 690, SLI'd GTX 680s, and CrossFireX'd Radeon HD 7970s all kick the snot out of the dual-Fermi GTX 590 (originally reviewed June 2011). In boring lockstep with Nvidia's promotional materials, the GTX 690 is between 20 percent (in Shogun 2) and 66 percent (in Unigine Heaven) faster than the GTX 590. It also draws less power—we saw a peak total system power of 567W for the GTX 690, compared to 613W for the GTX 590 and over 810W for each of the two-card setups. All four setups idled between 101W and 110W, though the AMD has ZeroCore technology, which drops card power consumption to just 3W when the attached monitor is off. Nvidia's cards lack this feature.

The GTX 690 isn't necessarily quiet, but it's not loud. We'd be happier if the airflow didn't wreak havoc on conventional cooling systems, but the central fan keeps both GPUs cool, so we can't complain too much.

Overkill, Or the Right Amount of Kill?

The Nvidia GTX 690 is the fastest consumer graphics card you can buy. It's roughly as fast as two GTX 680s and beats dual Radeon 7970s in most benchmarks. That is to say it's roughly twice as fast as the fastest single-GPU cards on the market. That's a big deal. Expect third-party vendors to ship factory-overclocked versions that'll be even faster.

It's also $1,000 dollars, and it's complete overkill for most gamers. Most people don't even need one GTX 680, much less two, unless you're gaming on multiple high-res panels. In 3D. On the other hand, GPU compute users, visual artists, and other people who need massive rendering power immediately but aren't in Tesla or Quadro territory might find the GTX 690 a budget option.

If you really do need multiple top-end GPUs, the GTX 690 takes up less room and draws less power than two 680s, but costs the same amount and makes less noise. It's the obvious choice for an SLI setup. And if you're an AMD fan? The Radeon HD 7970s still outperform a dual-Kepler setup in a few benchmarks, but AMD hasn't revealed its dual-GPU Southern Islands card yet. The rumored 7990 is just that: rumored. Given the performance of the GTX 690, though, we hope AMD has something special up its sleeve.

RADEON HD 7990: COMING SOON?

The Radeon HD 7990 is currently slated for a July 2012 launch, according to a source familiar with the project. Why not earlier?

First, our source claims that AMD's Radeon HD 7970 is handily outselling Nvidia's GTX 680, at least in part because of Nvidia's scarce supply of GK104 parts (though Nvidia denies any yield issues), so AMD's in no hurry to release a dual-GPU card. Second, most of AMD's driver engineers have been working on the Trinity APU. With Trinity's launch, those engineers are free to work on Radeon drivers. This leads us to the third thing our source said: AMD won't release the Radeon HD 7990 until it can beat the GTX 690, which the company thinks it can do in time for a July launch. Nvidia, by the way, says it doesn't anticipate a serious GTX 690 competitor for the next six to nine months. Fightin' words!

We hope the 7990 doesn't look as plain-Jane as AMD's last dual-GPU card, shown here.


50
45
40
35
30
25
10
15
20
5
60
50
40
30
20
10
0,2 s
16 JEWELS

By Gordon Mah Ung

BREAKING IN OUR NEW BENCHMARKS

WE UNVEIL A GAUNTLET OF NEW TESTS FOR PCs

There's a joke in the hardware community that the only thing a performance computer is good for is running benchmarks. This dis at benchmarking suggests that such performance measures are pointless.

We disagree. We honestly think that benchmarks keep the hardware world honest. They give you a real metric with which to measure one piece of hardware against another, or one system against another. Yes, there are times when politics get injected into benchmarks and they can be misapplied, cooked, or even cheated on. But think of what the world would be like without benchmarks. A vendor could make claims that his gadget is faster than the competitor's. An Internet declaration claiming a PowerPC Mac was 10 times faster than a Pentium II would stand as truth. A good benchmark run well and analyzed correctly can tell you more about a piece of hardware than any marketing flyer.

Since *Maximum PC*'s system benchmarks haven't been updated since the last decade, we're rolling out newer, more punishing tests that push today's hardware. We're also using real-world workloads such as gigapixel imaging and multiple 1080p streams to closely match what people are doing today.

With new benchmarks also comes a new zero-point system to give you a reference point for how today's fastest PCs perform. And after we've given you a tour of our official system tests, we'll point you to some benchmarks you can run at home on your own rig.

INTRODUCING OUR NEW ZERO-POINT

We didn't need benchmarks to tell us our Nehalem-based test bed was dragging ass

A hexa-core CPU and top-of-the-line GPU give us a good baseline against which to judge new systems.

If we tell you how fast some new $5,000 PC is, it doesn't mean much without a reference point. That's why we build standard zero-point PCs to compare machines to. It's hard to believe, but our previous zero-point is now several generations old. It's still serviceable for many folks, but when it's meant to be our measuring stick for some of the fastest production computers in the world, it better have some chutzpah.

In choosing our parts, we spent some time pondering whether to go LGA1155 or LGA2011. Quad-core or hexa-core? Single GPU or dual? In the end, we decided that more cores still matter, so Intel's Core i7-3930K would be the basis of our new ZP. Yes, it's based on the older Sandy Bridge microarchitecture, but it still has plenty of speed, and LGA2011 gives us an upgrade path to Ivy Bridge-E and perhaps an eight-core chip in the future. The 3930K is stock-clocked at 3.2GHz with Turbo Boost to 3.8GHz. We decided to override the stock clock and run it at 3.8GHz full time, with Turbo taking it to 3.9GHz.

For storage, we are finally unshackled from SATA 3Gb/s speeds with the X79 chipset, via an Asus Sabertooth X79 board. A 120GB OCZ Agility 3 gives us zesty SATA 6Gb/s reads and writes and has enough capacity to handle our benchmarks. For graphics, we've long used a single-card dual-GPU and we continue that trend with Nvidia's benchmark- and wallet-busting GeForce GTX 690. It's basically the equivalent of two GTX 680 cards—in performance *and* cost. The rest of the build is essentially borrowed from the $2,100 Tax Refund PC in our May 2012 issue and includes 8GB of 2GB DDR3/1600 in quad-channel mode, a 2TB WD Caviar Green drive, an 850W Corsair HX850 PSU, and an NZXT Phantom 410 case and Havik heatsink.

To create our benchmarks, this wasn't the only hardware we used. Additional testing was also done using a stock Core i7-3770K and GeForce GTX 580 card. We also tested our benchmarks using an OCZ Revo 3 X2 card to see how much of an impact I/O would have on the individual tests. It was negligible.

The total cost of our new zero-point? Roughly $2,500. That puts it in the upper echelon of what most people spend on a new machine, but certainly nowhere near the high-end rigs we've tested already.

SPECIFICATIONS

	OLD	NEW
CPU	2.66GHz Core i7-920 (at 3.5GHz)	3.2GHz Core i7-3930K (at 3.8GHz)
Cooler	Thermalright Ultra-120	NZXT Havik 120
Motherboard	Gigabyte X58	Asus X79 Sabertooth
RAM	6GB DDR3/1750 in tri-channel mode	8GB DDR3/1600 in quad-channel mode
GPU	AMD Radeon HD 5970	Nvidia GeForce GTX 690
SSD	160GB Intel X25-M	120GB OCZ Agility 3
HDD	1TB WD Caviar Black	2TB WD Caviar Green
PSU	Corsair TX850	Corsair HX850

MEET THE NEW BENCHMARKS

We chose our tests with an eye toward real-world workloads

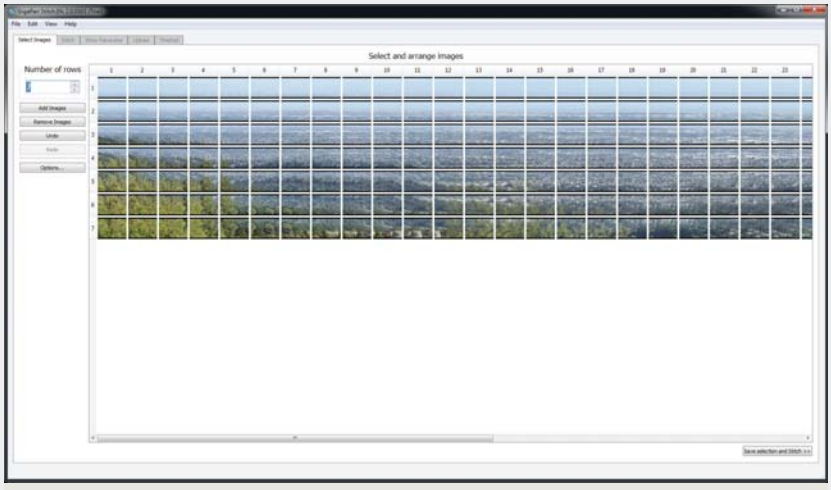
The GigaPan Epic Pro uses a motor to pan your DSLR to create gigapixel images.

ADOBE PREMIERE PRO CS6

We've been envious of the Mercury Playback engine since Adobe introduced it in Premiere Pro CS5. In Premiere Pro CS6, Adobe has tucked in even more enhancements to make it probably one of the fastest, if not *the* fastest, nonlinear editor on the planet. That presented a few problems for us, though: Do we render using the wickedly fast GPU or the CPU? Using the GPU could cut our times by several factors, but not all machines support the GPU encoding. In the end, our problem was solved for us, as the GTX 690 is not currently supported by the Mercury Playback engine, so it's CPU all the way. That doesn't mean the benchmark is a wimp. We find the multithreading in CS6 to be impressive. All 12 threads on our Core i7-3930K are hammered during the export. For the workload, we take 1080p video previously shot on a Canon EOS 5D Mark II, add transitions and moving picture-in-picture frames with additional 1080p footage, and export it to H.264 formatted for Blu-ray. The six cores in our 3930K pay dividends, as our render took about 33 minutes. A stock Ivy Bridge setup took about 53 minutes.

GIGAPAN STITCH.EFX 2.0

New to our stable is Stitch.Efx 2.0. Let's face it, applying a sepia filter and scratch effects can be done on a $50 smartphone. Since PCs are about going big, we went as big as we could get. We used a motorized GigaPan Epic Pro head, a Canon EOS 7D, and a 300mm lens with 1.4x teleconverter to shoot a panorama of 287 images totaling 1.63GB. Using Stitch.Efx we stitch the shots into a single continuous 1.1 gigapixel panorama. Yes, that's 1.1 *billion* pixels, or 1,100 megapixels. (That might sound like a lot, but it's nowhere near the current record of 272 gigapixels—also shot with an Epic Pro head and 7D.)

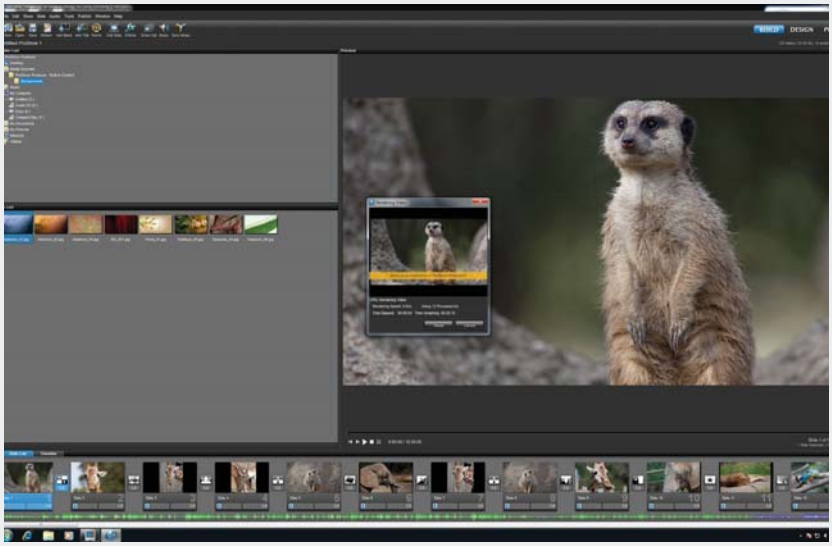


Stitch.Efx is one-third single-threaded and two-thirds multithreaded. We use it to stitch together 1.6GB of JPEGs into one single 1.1-billion-pixel image.

About the first third of the process, where the app aligns the images, is single-threaded and sensitive to clock and microarchitecture. Ivy Bridge cores give the Sandy Bridge cores a good run for the money in this section, but in the blend section it's all about the cores and this is where we see SB's greater number of cores pull ahead of the Ivy Bridge chip. As we stitched "only" 287 images together, it's mostly a CPU test, but we can say the process created no fewer than 24,339 files during the stitch, so small-file read and write performance should matter. With its mix of single- and multithreaded performance, Stitch.Efx2.0 is a good representation of today's software. Look for a review of the Epic Pro head on MaximumPC.com—perhaps we'll be going for that record ourselves.

TECHARP X264 HD 5.0

Since our Premiere Pro CS6 test actually features MainConcept's popular encoding engine, we cast about for another publicly available encoding test and found one in the newly released x264 HD 5.0. Created by tech website TechARP.com, the test uses the x264 library to encode a 1080p video stream multiple times. The benchmark is multithreaded and loves cores. It performs two passes, with the second pass compressing the compressed material even further to save space. We run in 64-bit mode and report the average frame rate for the second pass. In our testing, the hexa-core Core i7 smashes the newer Core i7 Ivy Bridge in the nose by a significant margin. We've found that encoders can be sensitive to memory bandwidth, so we reconfigured our machine from quad-channel to dual-channel mode (using larger DIMMs so the total amount of RAM would remain the same) and found a negligible difference.



ProShow Producer 5 gets GPU support, but for playback only. It's currently optimized for "only" quad-core support.

PROSHOW PRODUCER 5.0

Favored by professional photographers, ProShow Producer 5.0 is a popular slideshow creator that we've long used as a benchmark. For our new benchmarks, we update to the latest version of the app, which adds GPU acceleration, but only for video playback. When we started using ProShow Producer five years ago, it was one of the few apps that could push quad-core chips to their limit. Unfortunately, the app seems to top out with four cores, but that's fine. We intentionally picked ProShow Producer 5.0 knowing full well that it doesn't scale with cores. Like Stitch.Efx 2.0, we wanted something that's closer to most apps in performance instead of simply scaling as you add more cores. Why pick something that won't push an eight-core chip to its limits? The sad truth is that the vast majority of apps can't exploit the threads.

BATMAN: ARKHAM CITY

Arkham City is based on a heavily modified version of the Unreal Engine 3 and adds the latest DX11 bells and whistles. We run the test at 2560x1600 with 8x AA, tessellation on High, and detail on Extreme. Why not use some of the more advanced AA settings available from Nvidia or AMD? Since this test will be used on systems, it can be difficult to compare a proprietary anti-aliasing technique from one vendor against another vendor that doesn't support it. Even at 8x AA and everything cranked up, the GeForce GTX 690 makes mincemeat of the benchmark.

FUTUREMARK 3DMARK 11

Our last benchmark is Futuremark's 3DMark 11. We normally eschew synthetic benchmarks in favor of real-world benchmarks, but we have relied on the various iterations of 3DMark over the years. We're choosing it here because it scales well with multiple GPUs, and this version doesn't seem to represent the typical game of political football between rival graphics companies that previous versions have. For our test, we run the default benchmark for the Extreme preset.

BENCHMARKS

	ZERO POINT	
Premiere Pro CS6 (sec)	2,000	3,067 (-35%)
Stitch.Efx 2.0 (sec)	831	893 (-7%)
ProShow Producer 5.0 (sec)	1,446	1,522 (-5%)
x264 HD 5.0 (fps)	21.1	14.3 (-32%)
Batman: Arkham City (fps)	76	21 (-72%)
3DMark 11	X5,847.0	X2,115 (-64%)

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

For comparison, we ran our benchmarks on a stock quad-core 3.5GHz Core i7-3770K on an MSI Z77A-GD65, with 8GB of RAM, a GeForce GTX 580, a WD Raptor 150 drive, and 64-bit Windows 7.

HOW TO BENCHMARK LIKE AN EXPERT

Lessons from the Lab that you can apply to your own testing methods

As any veteran nerd will tell you, running a benchmark is just half the equation. The other half is actually being able to understand the limits of the benchmark and how to analyze the results. You can't, for example, use 3DMark to evaluate your hard drive performance. Most people know this, but do they know the limits of other benchmarks?

THE FUNDAMENTALS

Before you begin your benchmarking, there are a few basic rules that every techie has learned through blood, sweat, and tears. First, record all your settings. From bclock, to RAM timing, to GPU clocks, drivers, and BIOS settings, you should keep a written record that you can refer back to. Second, you're human and make mistakes. If the result from B outrageously exceeds A, assume you made a mistake and retest. Third, double-check your system. Are you in the correct SATA port? Is the RAM fully inserted and in the correct memory mode? Is the CPU overheating and throttling? Fourth, triple-check your settings. Yeah, this is the second tip again, but more often than not, user error is the cause of errors in tests. Finally, benchmarking doesn't have to cost money. Here are a few free and reliable benchmarks and how to interpret their results.

MAXON CINEBENCH 11.5

Cinebench 11.5 is a great test of pure CPU performance. The benchmark is based on Maxon's Cinema 4D rendering engine and is heavily multithreaded. The test also features an OpenGL rating. So what's the catch? Cinebench's rendering test is best used to test CPU performance *only*. As a system level test, any variances you see between system A and system B will be due to the CPU and not the hard drive, SSD, or memory bandwidth. It's virtually worthless to try to use it as, say, a motherboard test using the same chip, because any variances will be due to how much the vendor tweaks the board's bclock settings. OpenGL also has little value for mainstream users, as very few games even use OpenGL anymore. www.maxon.net

TECHARP X264 HD 5.0

We've just started using TechARP's x264 HD 5.0 benchmark, but we like it already. It gives you an easy, repeatable way to test the encoding prowess of a machine. Be advised that, like Cinebench, it seems to be almost completely compute-bound. We tested it in dual-channel mode and quad-channel mode on a hexa-core chip and found a very minor difference resulting from memory bandwidth. Testing from a single SSD to a RAIDed PCIe SSD also yielded very little difference. www.techarp.com

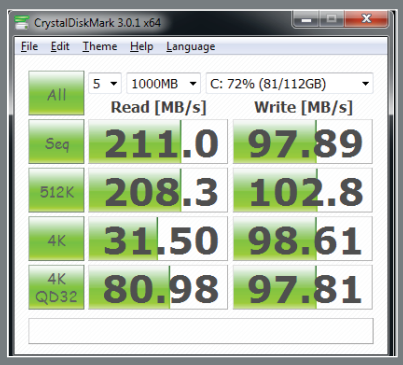
UNIGINE HEAVEN 3.0

For graphics, Unigine's Heaven 3.0 is a great way to measure tessellation performance and will push even the fastest cards. It even has a Mac version, but without tessellation. Multiple GPUs help this benchmark, which is purely focused on the GPU. Quad-core, hexa-core, low clock, or high clock hardly make a difference in this test. The free version of Futuremark's 3DMark11 will also work—but only for the Performance preset. www.unigine.com

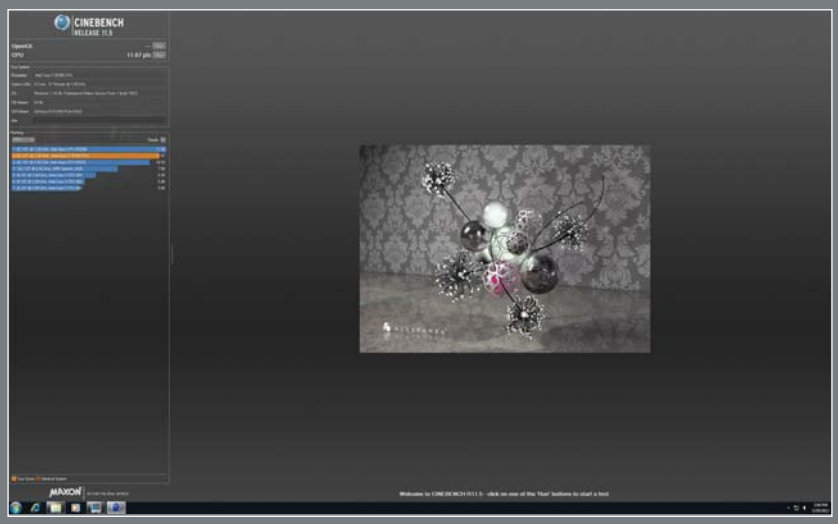
CRYSTALDISKMARK 3

We've also been happy with CrystalDiskMark, which is easy to run and gives you a good feel for your disk subsystem's performance. Keep in mind, one limit with the test is that the workload is limited to 4GB, so even a hybrid drive could perform like an SSD. www.crystalmark.info

Folks interested in measuring their memory bandwidth should check out SiSoft Sandra 2012 (bit.ly/LaYsdy). The free version offers a host of benchmarks, including a synthetic memory benchmark. Keep in mind, though, with the large-cache CPUs today, it's very difficult to see an impact from memory bandwidth unless you are running integrated graphics.



CrystalDiskMark 3.0 is a reliable way to measure disk performance but not across an entire disk or SSD.



Cinebench 11.5 is best used as a pure CPU-performance benchmark and applications outside of that should be carefully weighed.

iFixit presents:

AUTOPSY

THIS MONTH WE DISSECT...

Barnes & Noble Simple Touch with GlowLight

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their products. To learn more, visit www.ifixit.com.

MAJOR TECH SPECS:

In an attempt to solve the centuries-old problem of how to read in the dark, Barnes & Noble brings us a revamped version of last year's Nook Simple Touch. The specs are identical to that model, with one main addition:

- Adjustable GlowLight technology

- 2GB internal storage, supports up to 32GB of additional storage via microSD card

- 16-level grayscale 6-inch E-Ink touchscreen with a max resolution of 600x800 pixels

- 802.11b/g/n wireless connectivity

KEY FINDINGS:

- It appears that only a single T5 Torx screw, which is easily removed with our 54 Bit Driver Kit, stands between us and the glowing innards of the newest Nook.

- Although the concept behind Barnes & Noble's GlowLight technology seemed super-simple at first—just some inexpensive LEDs on top of the screen—we knew there had to be more tech packed inside in order to evenly light the screen.

- The glass in the display assembly includes a diffraction grating that disperses the light from the Nook's eight LEDs to achieve even distribution. Barnes & Noble must have spent a good amount of time optimizing this diffraction surface for the uniform lighting, which is why it has kept the technology in-house and is filing for a patent.

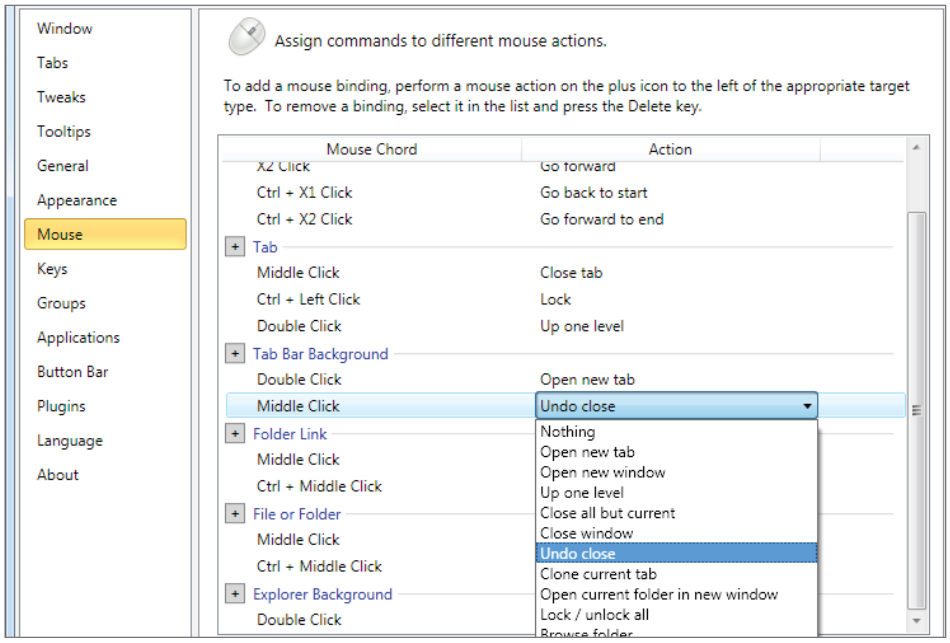
- Besides uncovering the magic of GlowLight, we found this device to be quite similar to the older Simple Touch. The board looks almost identical, save a connector for the GlowLight LEDs. The other noticeable difference is a frame made out of magnesium, as opposed to the aluminum plate found in the non-lit Simple Touch. (We verified this magnesium claim the hard way, as our burnt fingers will attest).

- Barnes & Noble claims that the battery provides, at an average of one hour of reading per night, one month of usage per charge with the GlowLight on or two with it off.

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

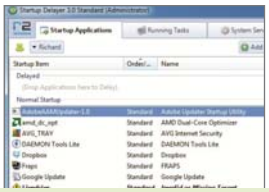
WINDOWS TIP OF THE MONTH

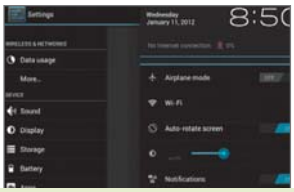


UPGRADE WINDOWS EXPLORER WITH QTTABBAR

Why is it that Windows Explorer—one of the most fundamental aspects of the Windows experience—has evolved more slowly than any other part of the OS? Force Explorer into the new millennium with QTTabBar, a mod package that adds tabbed browsing and tons of customization to good ol' Explorer.exe. It's in active development at http://qttabbar.sourceforge.net.

MAKE - USE - CREATE





ALEX CASTLE
ONLINE MANAGING EDITOR

THREE TYPES OF SLOW PC

WHEN I'M trying to figure out why a PC's running slowly, I start by grouping it into one of three broad categories:

Puny hardware: This is what us computer nerds always wish the problem was. Who doesn't love an excuse to buy some more RAM, after all? Easily diagnosed with dxdiag or the Windows Experience Index, it's the least common culprit.

Badware: Viruses and malware can cause the worst slowdowns, and are usually fairly easy to notice. Diagnose and remove with antimalware programs like Spybot Search & Destroy and Malwarebytes' Antimalware.

Just plain too much stuff: The most common and most frustrating cause, too many installed programs will slow your computer down even if they're not malware. Diagnose with hard disk visualizers (see last month's column) and the System Resource Monitor, and treat with CCleaner and Startup Delayer.

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

Speed Up Boot Times with Startup Delayer

YOU'LL NEED THIS

STARTUP DELAYER
This free tool lets you define a priority list of the order in which booting tools should be loaded into memory. It can load these utilities over a set amount of time or when it sees your machine isn't busy.
www.r2.com.au

PROGRAMS SHOULD know their place, sitting on your desktop silently and unobtrusively until called for. Instead, more and more of them try to run every time you load Windows, slowing your PC to a halt regardless of whether or not you want to check for updates, log into your games service, or whatever else they do.

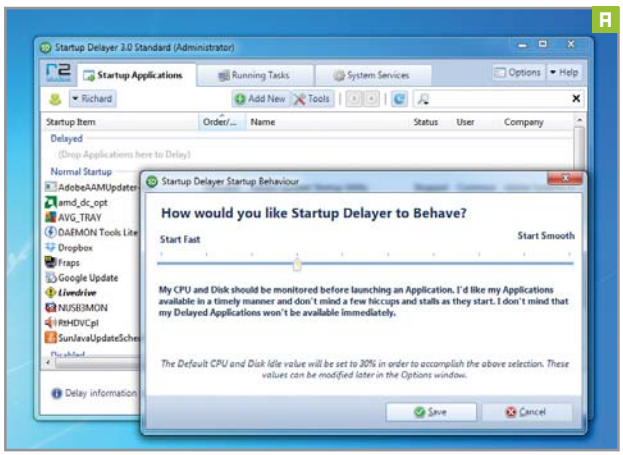
The more software you have installed on your machine, the more you'll notice the problem—to the point that there can be whole minutes between your desktop appearing and you being able to do anything with it. Luckily, there are ways to cut through all this. First we'll do a little spring cleaning. Then you'll find out how a tool called Startup Delayer can space out the applications you do want to load automatically, letting Windows handle them quickly, efficiently, and discretely behind the scenes.

1 MAKE MANUAL TWEAKS Boot your PC and, without loading anything, click the arrow icon in the system tray to see which programs load automatically. Right-click each one to bring up a menu that should explain what they are. Common apps include your graphics card Control Panel, software update checkers, and antivirus, but every PC will be different.

» Some programs, like antivirus software and Dropbox, need to be loaded and running, and can be left as they are. Other apps, like Steam, can be loaded when you need them. Right-click each of these and look for an option along the lines of "Run when Windows starts." If you don't see one, open it, and look in its Preferences/Options menu instead.

2 GET STARTUP DELAYER Open your web browser and visit www.r2.com.au to download Startup Delayer. Launch the setup file, letting it make a System Restore Point just to be on the safe side, and allow it to run. It will take a few seconds to scan your PC for applications and give you the option to load the help file. You can safely skip this part, at least for now.

» First, you need to tell Startup Delayer your priorities. These are based on a sliding scale that goes from loading your applications as fast as possible (all the way to the left) to only loading the next one when your PC is effectively sitting idle. As a starting point, we recommend going with the third or fourth notch from the left **(image A)**.

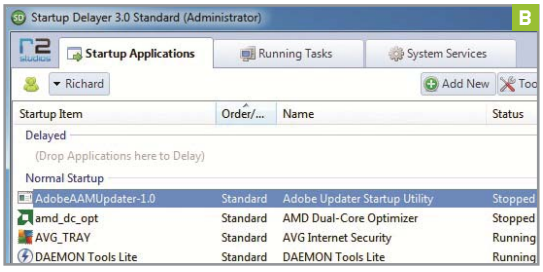


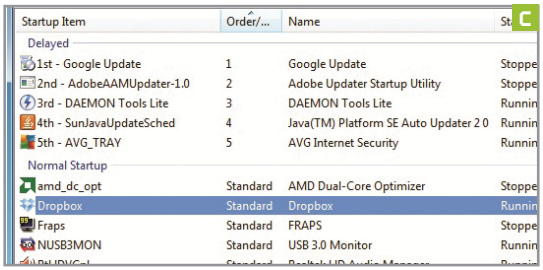
3 CONFIGURE YOUR LAUNCH ORDER By default, all programs are classed as Normal Startup, which means Delayer loads them as soon as possible **(image B)**. Essential software like antivirus should remain here, but the rest can be set as Delayed, meaning they wait until your PC is sitting idle. You can also drag apps into Disabled if you can't prevent them from loading automatically.

» Once they're in the Delayed list, you'll see that each application is numbered **(image C)**. This is the order in which Startup Delayer will load them when it finds a quiet moment. To reorder them, simply select one you wish to move, click on it, and drag it into its new position. Applications in the "Normal" list don't have a number, all being loaded at once.

» If necessary, you can take charge of individual applications by selecting them, then assigning either an automatic (based on how hard your processor/hard drive is working) or timed delay. Both of these options are listed at the bottom of the screen. You can also hold Shift or Ctrl to select and delay multiple applications at once.

» Restart your PC and see the difference. The more applications you had running the greater improvement you'll see, but any machine should feel noticeably faster.





Install Android on Your PC

–Graham Morrison

YOU'LL NEED THIS

A SUITABLE PC

You can use any PC for pre-ICS Android, but you'll need a netbook or Intel-based machine if you want to try experimenting with Android 4.0 Ice Cream Sandwich.

USB STICK/VIRTUALBOX

You'll need the stick for some installations and VirtualBox 4.18 for others (www.virtualbox.org).

ANDROID

We're using the Nightly build of Android 2.2 from http://android-x86.moonman.dk, and the ISO image of 4.0.3 built for the generic platform from www.bit.ly/xwBkmY.

THE GREAT THING about Android is that it's open source, which means any developer can grab the code to Android and do what they want with it—and now you can, too. With a little work, you can get Android running on your PC right now, for free.

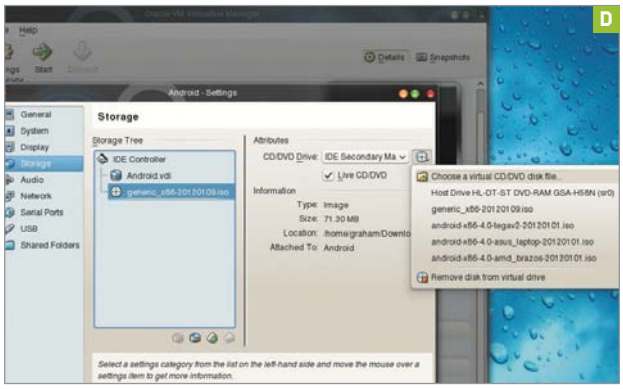
The main challenge is that most Android devices run on ARM processors, and porting it to run on anything else is a big challenge. Google does provide tentative support for the x86 architecture within the codebase, but it wouldn't be possible at all without the existence of a project called Android-x86 that pulls all this together with a considerable library of patches to create a build of Android that mostly works on Intel or AMD processors.

The project has been able to make earlier releases of Android run fairly stably on the x86 platform, including networking and mouse support. But the Ice Cream Sandwich version of Android still has some bugs running on x86, so we'll start by showing you how to install an earlier, more stable build on your PC.

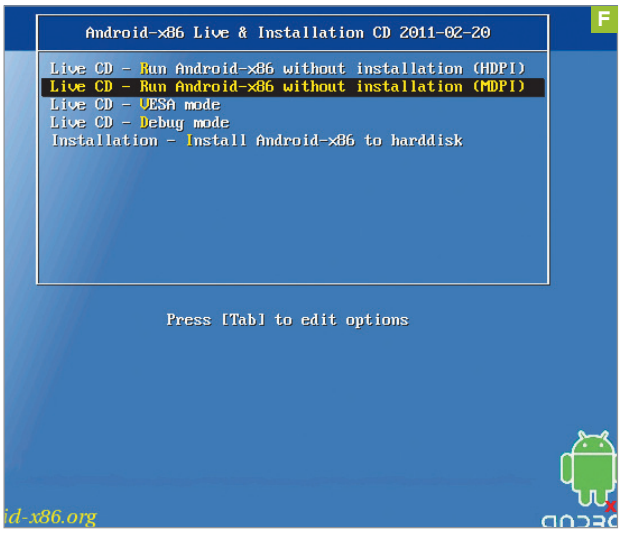
1 SET UP A VIRTUAL PC We'll take our first foray into Android by running an older version in a virtual machine environment. This is safe, maximizes functionality, and walks a well-trodden path. If you like it, you can move onto a newer version later. We used VirtualBox, though other virtualization programs should work, as well. Android works better on Intel hardware due to modifications in the source code, but we saw no difference on our AMD machine aside from a couple of warnings.

» We've had the best experience with the Nightly build of Android 2.2, which you can grab from http://android-x86.moonman.dk. With the ISO downloaded, launch VirtualBox and click the New button. In the wizard that appears, set the operating system to Linux, and set Other Linux as the version. We gave our machine 512MB of memory, and a 2GB hard drive as a VDI disk image.

» After the new machine has been created, select it in the machine list and open the Settings window. On the System page, switch to the Processor tab and make sure Enable PAE/NX is active for your CPU. Now click the Storage page. VirtualBox defaults to IDE emulation rather than SATA, and we need to add a second device to attach to our ISO image. If the device doesn't exist, click the controller followed by the "Add a new attachment" icon (which looks like an optical disc). A small window should appear asking you to choose a disc image, and you should point the resulting requester at the Android 2.2 image. If an optical drive already exists, select it in the storage tree. Use the disc icon on the far right to display a drop-down menu, then select "Choose virtual CD/DVD disk file" **(image D)**.



2 INSTALL ANDROID 2.2.1 Now that everything is configured **(image E)**, click OK in the Settings window, and then click the green Start button in the main interface. Android 2.2 will boot within the virtual machine. You'll see the boot menu **(image F)**, from which you should choose the first option. HDPI and MDPI refer to the screen resolution of the output device, which you can ignore when running on anything other than a tablet. If you decide to try this boot on real hardware, then the third option avoids graphics drivers by using the VESA mode. This is useful if you run into compatibility problems. If you like what you see with Android, the final option will create a permanent installation on a spare drive partition. A few moments after making your choice, you'll see Android's unlock screen. The final hurdle is overcome by pressing the right Ctrl key and selecting "Disable mouse integration" from the Machine menu. Now when you click the virtual machine, you should see the mouse and be able to slide the padlock icon up to enter the OS.



3 UPGRADE TO THE REAL DEAL Hopefully you've now played with Android 2.2 and want to upgrade to the latest version. We'll show you how to install the Ice Cream Sandwich Android build on your PC, without virtualization. But before you can begin, you'll need to go to the Android-x86 Project's homepage and download the most recent Ice Cream Sandwich build (also known as Android 4.0.3) compiled for generic x86 hardware.

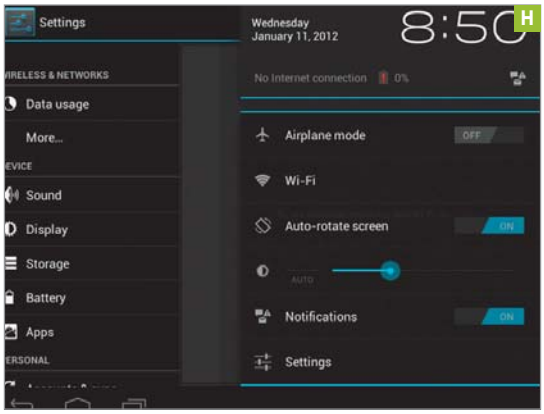
» You can either burn the Android ISO file you downloaded to a CD or onto a USB stick, which can then be booted on the machine. If you want to create a bootable disc, you'll need to download UNetbootin, which you can download at http://unetbootin.sourceforge.net.

» First, insert your USB stick—1GB will do. All the data will be lost, so make sure there's nothing on there you want to keep, then launch UNetbootin. The top half of the window is used for selecting a Linux distribution, which can be downloaded and installed automatically. We want to use the bottom half to locate the ISO and ensure the correct USB device has been selected **(image G)**. If everything is correct, click OK. This will start the conversion and begin to write the bootable data to your USB stick. It should complete in a few minutes.

» Like a live Linux distribution, Android can now be booted by turning on your machine with the CD or USB device inserted. As long as the BIOS or boot menu is configured to probe the right device first, you should see the Android boot menu. This has three options, with Default being added by UNetbootin. Choose the first, "Run Android x86 without installation," to test the OS. If everything works, you can choose to install at a later time. Android takes a few minutes to boot. After the Android logo, you'll see the starter wizard. This is where, on a real device, you sync the hardware with your Google account, but without network connectivity it makes no sense. Just click through the options to get to the OS quickly.

» You'll now see the start page of Android. This adds a few prompts to help you get started, but Android is easy enough to use without any prior experience, especially if you tried version 2.2.3 earlier. The main differences are in the transitions and how the display looks, but all that can be changed, too. Applications are launched from the small matrix icon on the top right, and you can use the arrows in the bottom left to move between what Android calls "activities." In normal terms, these are virtual desktops.

» Playing with the settings is the first thing you should do. You can get to the Settings panel **(image H)** by clicking the clock in the bottom right of the display, then on the text that says "No Internet connection." Clicking the Wi-Fi icon will turn it on, and hopefully you'll be able to scan for networks with the Scan button at the top of the screen. Again, Android on x86 is still a work in progress, so features like networking may not work with your hardware. If you encounter problems, remember to check back soon—the project is updated frequently.



BUILD IT

GORDON MAH UNG **DEPUTY EDITOR**

Reliving the Commodore 64 Glory Days

How to build a modern-day PC into a replica of the world's bestselling computer

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

THE MISSION Many people wax poetic about the polite '50s, the radical '60s, or the wild '70s, but for nerds, the 1980s was the best decade. A full-on war raged in the new category of "personal computer," no one operating system ruled the world, and, man, you could walk into a Toys "R" Us and buy the world's all-time bestselling PC: the Commodore 64.

Whether you want to relive the golden age of PCs or you weren't alive for it, Commodore USA (no relation to Jack Tramiel's original Commodore International) offers its Commodore 64x to recreate that 1980s experience.

The main difference between the original C64 and this replica is the latter's ability to take standard PC industry components. Is the Commodore 64x case/keyboard a perfect recreation of the original? No, but it's damn close. I'm not judging this by my faded memories of the C64 I owned in 1982, either. See how closely the inset shot of the original resembles the new C64x?

Original C64

WHAT'S INSIDE THE NEW C64?

I HAD ENVISIONED using a Core i7-2600K with a notebook GeForce graphics card in the C64x, but I quickly realized that heat would be a serious issue in this thermally constrained PC, which has one puny 4cm fan handling all its airflow. I also considered a mobile Core i7, but the cost and scarcity of parts made me ditch that approach. In the end, I decided that an AMD E-350 Fusion APU would be the most cost-effective and reliable route.

The best candidate for the job? Zotac's Fusion ION-ITX T Series. The board features AMD's E-350 Fusion chip, built-in Wi-Fi, and, best of all, a 90-watt external power brick. Because the C64x doesn't have much room, running an internal power supply is out of the question. Pico-ITX PSUs are an option for standard boards, but that would require cutting a hole into the chassis to route the wiring. The Fusion ION-ITX T Series takes care of that in one swoop. Thermals also shouldn't be an issue with its integrated heat pipe and heatsink. My previous experience has taught me that the E-350 runs super cool for an 18-watt part.

For storage, I opted for Seagate's Momentus XT hybrid drive. It gives the C64x some SSD-like performance but is cheap enough that I can afford to give the machine 750GB of storage space. A Silverstone slot-fed DVD burner rounds out the package, but we did have to add an NZXT internal USB expansion module and an old-style Molex Y power splitter.

For tools, a standard Philips-head screwdriver and a small jewelers Philips-head screwdriver are required for the build. I also had to round up a set of system screws, as well as a set of screws that are typically used to mount an internal 5.25-inch optical drive.

INGREDIENTS

	PART	URL	PRICE
Case	C64x	www.commodoreusa.net	$345
PSU/Mobo/ CPU/Cooler/ GPU	Zotac Fusion ION-ITX T Series	www.zotac.com	$199
RAM	Corsair 8GB DDR3/1333 SODIMMs	www.corsair.com	$44
ODD	Silverstone SST-S0-D02	www.silverstonetek.com	$69
HDD	Seagate Momentus XT 750GB	www.seagate.com	$155
Miscellaneous	NZXT IU01 USB Expansion module	www.nzxt.com	$20
	One Molex Y-power splitters	www.newegg.com	$1
	Zalman Fan Mate 2	www.zalman.com	$7
Total Cost			$840

1 OPEN THE CASE

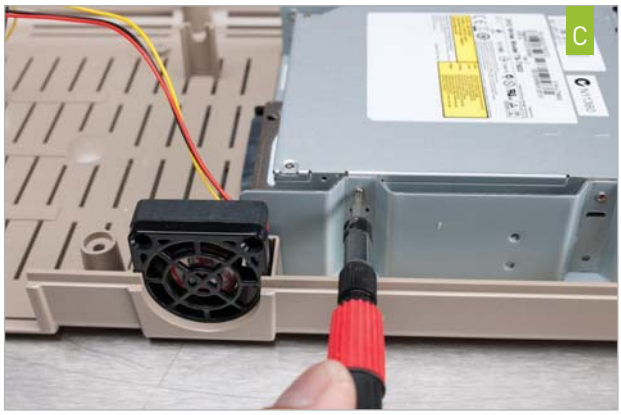
YOU'LL NEED TO unscrew six screws along the perimeter of the C64x first **(image A)**. Then carefully remove the keyboard and place it aside. Now, find a cassette tape player and put in your favorite mix tape of Olivia Newton-John, Survivor, Joan Jett, the J. Geils Band, and the Human League. Yes, all the top artists of 1982.

2 REMOVE THE DRIVE TRAY

UNSCREW the four screws under the C64x. Note: You will probably have to loosely hold the four nuts inside the case to get them loose. Once the screws are out, remove the tray and mount the 2.5-inch drive **(image B)**. The drive tray is countersunk to fit countersunk screws. Since Commodore USA doesn't include these parts (when they say bare-bones, they mean it), we used four fine screws of the type that comes with a 5.25-inch optical drive to hold the drive in place. This will cause the tray to ride a little higher than it should, but don't worry: The loosey-goosey build quality of the drive opening means the tray should still fit it. Mount the drive tray back in place and screw it into the case using the four screws and nuts.

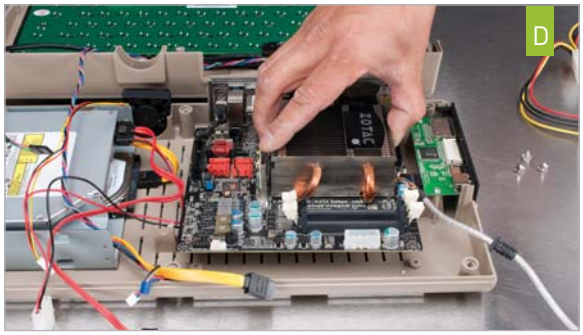
3 INSTALL THE OPTICAL DRIVE

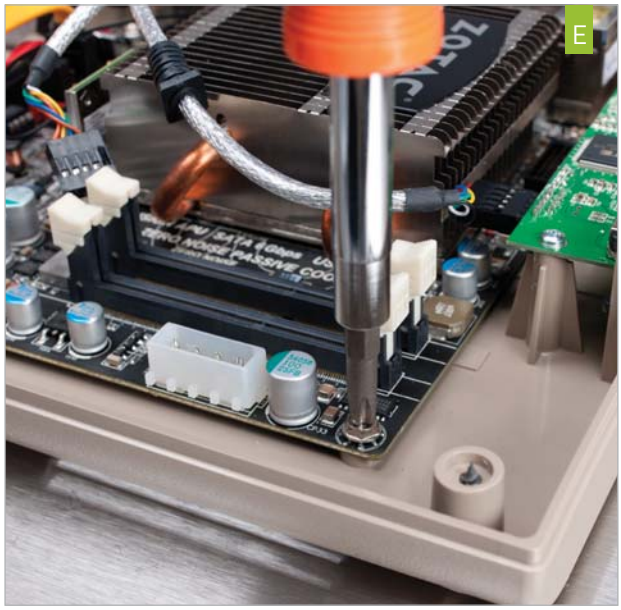
WE COULDN'T FIND a 170KB 5.25-inch floppy drive, so we settled for this Silverstone slot-fed DVD burner. It comes with four tiny screws. Place the drive in the cage and screw it in place with the jeweler's screwdriver **(image C)**. Now plug in the HDD power and SATA cable as well as the ODD power and data cable.


C

4 INSTALL THE ALL-IN-ONE MOTHERBOARD

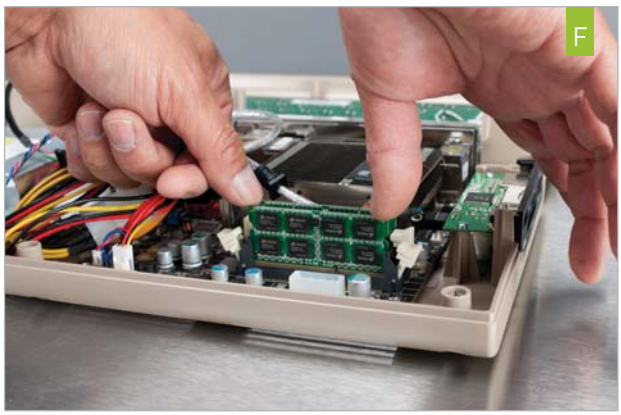
INSTALL THE I/O shield by sliding it into the slots at the rear of the C64x. Now gently slide the Zotac motherboard into place, making sure the two Wi-Fi antennas feed out the holes in the I/O shield **(image D)**. Take four screws from your spare parts box (because why would Commodore USA bother to include them in the box?) and gently screw the board in place **(image E)**. The board doesn't have metal standoffs, so you'll be boring the screws into plastic. Do not over-torque the screws or you will strip out the mounts.


D


E

5 INSTALL THE RAM

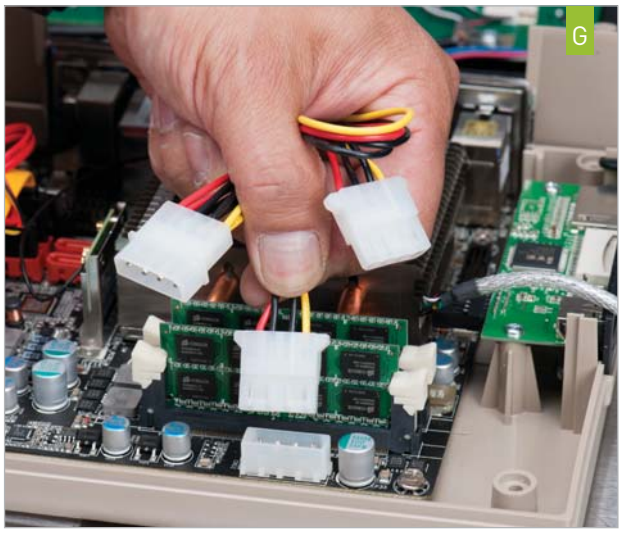
INSTALL THE PAIR of SODIMMs by placing them into the slots while carefully making sure the notches in the DIMMs line up with the notches in the slots. Apply pressure with your thumbs on the corners until the arms snap into place **(image F)**.


F

6 EXPANSION NEEDED

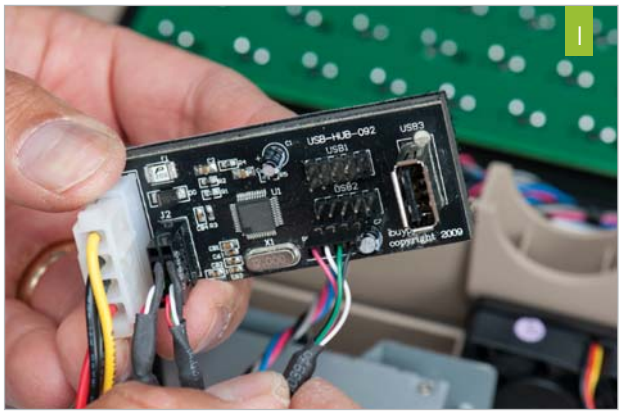
SINCE THE KEYBOARD is internal, it hooks directly into a USB 2.0 header. Unfortunately, the system's internal media card reader also requires a USB 2.0 header, but the Zotac board we selected has only one internal USB 2.0 header and a USB 3.0 header. To get around this, we used an NZXT 1U01 USB expansion module. The 1U01 needs power, so take the Molex Y-cable splitter and plug it into the Molex output on the motherboard **(image G)**. Now take the Molex-to-SATA power connector that came with the motherboard and plug it into one end of the Y-cable splitter. Plug the other end into the 1U01's power pass-through and then plug into the optical drive's Molex cable.

Windows 7's installer works fine with the NZXT 1U01 expansion module, but if the OS you're installing doesn't like it, you'll need to use a USB keyboard during the OS install in order for the installer to recognize your keyboard. Note that the expansion module shown in the photo is slightly older than the current 1U01, but the install is the same, and we tested with both units just fine.

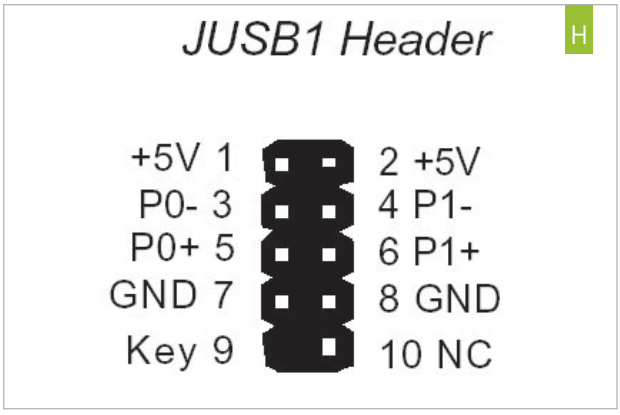

G

7 HOOK UP THE KEYBOARD

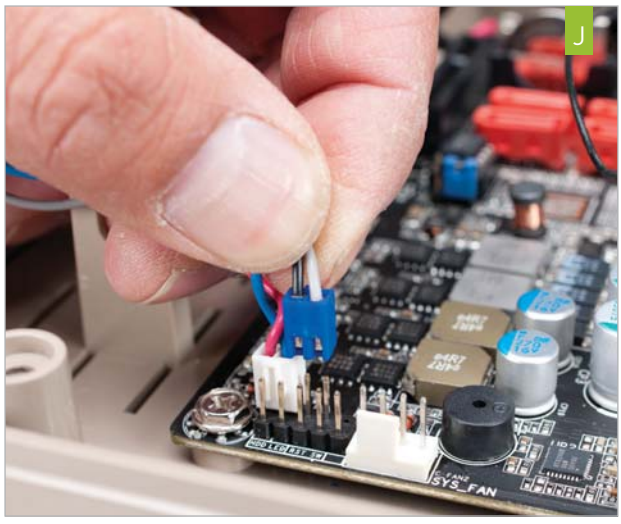
THE USB CABLE isn't labeled, but the wires indicate what functions they do. The red wire is power and the black is ground. Look at the USB pin-out chart we've provided **(image H)** and match the keyboard connector that has the red wire with one of the +5V pins and then plug it in **(image I)**. If you're still skittish, you can grab one of those USB header adapters that ship with MSI and Asus boards. Plug the power switch and power LED into the board's front-panel connectors **(image J)**.



I



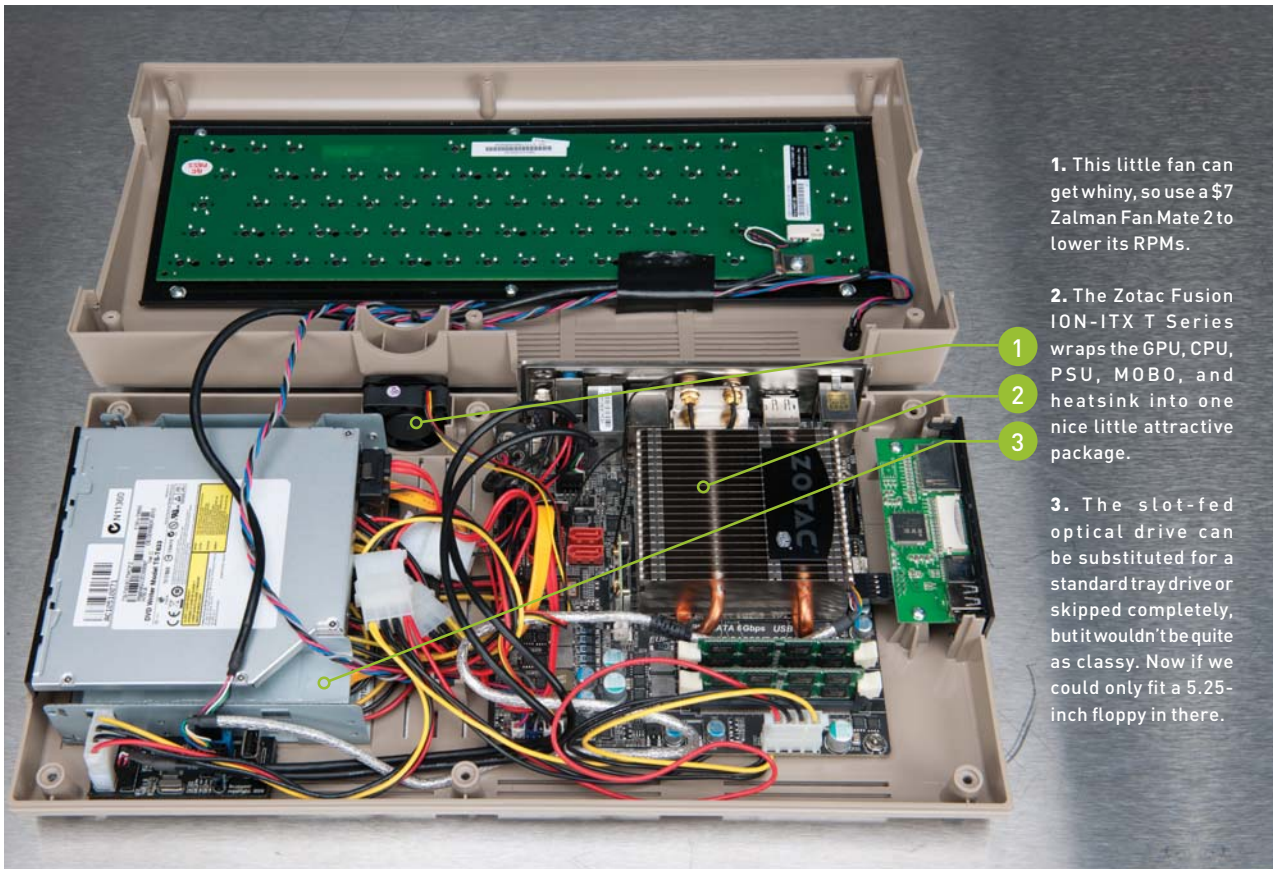
H



J

8 BACK TO THE FUTURE

YOU'RE READY to turn on the Commodore 64x. If you're wondering where the power button is, it's the red LED dome on the right-hand side.



1. This little fan can get whiny, so use a $7 Zalman Fan Mate 2 to lower its RPMs.

2. The Zotac Fusion ION-ITX T Series wraps the GPU, CPU, PSU, MOBO, and heatsink into one nice little attractive package.

3. The slot-fed optical drive can be substituted for a standard tray drive or skipped completely, but it wouldn't be quite as classy. Now if we could only fit a 5.25-inch floppy in there.

AN ELEGANT WEAPON FOR A MORE CIVILIZED AGE

THE ORIGINAL Commodore 64 packed a 1MHz MOS 6510 processor, which probably has one hundredth of the power of the CPU in your printer. Next to that, the AMD's E-350 "Brazos" would appear as magic from the gods. In our world, though, the E350 is pretty far off the power band as you can see from our tests. The E-350's main weakness is its x86 performance. The Fusion APU is faster than a dual-core Atom 330, but beefier parts such as Intel's Core i5-2430M—even with the i5's low clocks—will leave it in the dust. Where the E-350 in the C64x does well is in 3D performance—its integrated graphics solution has enough power to run older games such as Call of Duty 4: Modern Warfare at lower resolutions.

The real beauty of the E-350 is its low temps. At 18 watts for CPU and GPU combined, it really stays cool. In our experience, it's far cooler than Intel's own low-voltage 35-watt dual-core Sandy Bridge chips. The E-350 isn't about blistering performance, but neither is the C64x. It's about the cool factor of having a retro exterior with modern computer brains.

BENCHMARKS

Model	Commodore 64x	Giada i50	Giada Ion-100	Zbox Plus Nano XS
CPU	1.6GHz AMD E-350	1.2GHz Intel Core i5-430UM	1.3GHz Intel Atom 330 w/ Nvidia Ion	1.6GHz AMD E-450
Photoshop CS3 (sec)	445	**272**	552	423
MainConcept (sec)	8,280	4,736	8,858	**4,560**
3DMark 2003	5,685	1,189	3,371	**6,954**
Quake III (fps)	**204**	87	118	161
Quake 4 (fps)	38	9	29	**40**

Best scores are bolded.

REVIEWS

TESTED. REVIEWED. VERDICTIZED.

INSIDE

COOLER MASTER TPC 812 PAGE 87

Samsung Series 9

15 inches of Ultrabook goodness

AS WE LEARNED with the Acer Timeline M3 we reviewed last month, Ultrabooks are not only growing in number, but in size. That's the case with Samsung's new Series 9, which comes in both 13.3- and 15-inch flavors. We took the latter for a spin to see how a larger footprint impacts the overall experience.

Whereas the Timeline M3's 15-inch chassis pushed the boundaries of ultraportability with the inclusion of an optical drive and discrete graphics, the 15-inch Samsung Series 9 offers neither amenity and thus remains exceedingly thin, with a profile that's just .58 at its thickest. It's almost a pound lighter than the M3, too, at 3 pounds, 11 ounces.

So what does the larger size get you, if not added features? A larger screen, of course, along with a higher resolution. Folks who object to the 1366x768 res of nearly all of today's 13-inch Ultrabooks will appreciate that the 15-inch Series 9 ups the ante to 1600x900 (as does the 13-inch Series 9, for that matter), matching just Asus's UX31E in pixel count. Unlike the UX31E, and all other Ultrabooks we've seen so far, the Series 9's screen has a matte surface, for a pleasantly reflection-free experience. It also gets quite bright, making it usable outdoors. Still, it remains a TN panel like the others, complete with the narrow viewing angles.

The Series 9's keyboard also benefits from the wider footprint. The keys are nicely sized and spaced apart for comfortable typing, provided you don't mind the shallow key press of the island keyboard. Backlighting is enabled when ambient lighting is sufficiently dim. The touchpad with integrated right and left buttons is large, smooth, and generally free of glitchiness, although multitouch gestures can be hit or miss.

The Series 9's extreme thinness takes a slight toll on the ports department. The Ethernet port, for instance, is miniature, requiring use of an included dongle. For external display purposes, you get Micro HDMI and a shrunken VGA port, the dongle for which is sold separately. But those ports along with two USB 3.0 ports, one USB 2.0 port, and a media reader, meet the most common connection needs.

The Series 9 is a decent performer for this class, although we're curious as to why Samsung went with the Core i5-2467M proc when the Core i5-2557M costs the same but has a 100MHz higher base clock and 300MHz more Turbo headroom. It amounts to the difference in scores between the Series 9 and our Asus UX31E zero-point (save for the latter's anomalous Photoshop score). The Series 9's 6Gb/s SSD makes for speedy sequential reads and writes (429- and 262MB/s, respectively), but offers a paltry 128GB of capacity. The notebook boots and resumes from sleep in short order, and the battery lasted a generous five hours and 29 minutes in our video rundown test.

Like many other Ultrabooks, the Series 9 has a unibody aluminum construction, but it eschews the brushed-metal aesthetic in favor of matte black surfaces accented by a polished aluminum edge. It's a subtly handsome chassis with a strong hinge and sturdy feel. Is it worth its $1,500 asking price, which is on the high-end of the Ultrabook market? It is if you like the idea of a 15-inch ultraportable. –KATHERINE STEVENSON

VERDICT 9

Samsung Series 9

+ COFFEE 15-inch matte screen with 1600x900 resolution; sturdy, attractive chassis; capable performance.

– FOUR LOKO Miniature Ethernet and VGA ports require adapter dongles; tough sell against the similarly spec'd but less expensive Asus UX31E.

$1,500, www.samsung.com

BENCHMARKS

	ZERO POINT	
Premiere Pro CS3 (sec)	1,080	1,200 (-10.0%)
Photoshop CS3 (sec)	168.3	131
ProShow Producer (sec)	1,347	1,457 (-7.5%)
MainConcept (sec)	2,354	2,551 (-7.7%)
Quake III (fps)	217.3	214.2 (-1.4%)
Quake 4 (fps)	46.6	47.9
Battery life (min)	310	339

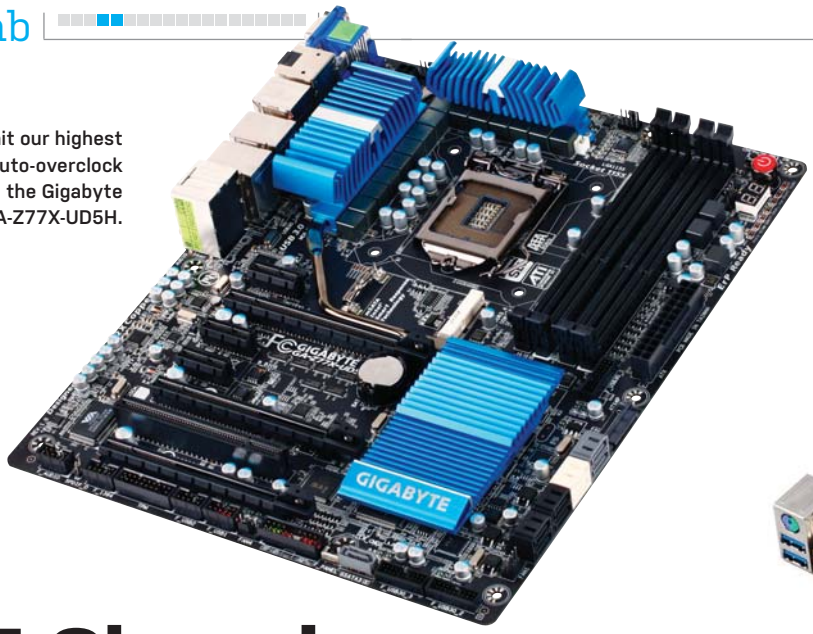
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

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	8GB DDR3/1333, dual-channel
Chipset	Intel HM65
Display	15-inch, 1600x900
Storage	Samsung 128GB SSD
Connectivity	1 USB 2.0, 2 USB 3.0, Mini VGA, Micro HDMI, Mini Ethernet, headphone/mic, webcam, Bluetooth, Wi-Fi, 4-in1 media reader
Lap / Carry	3 lbs, 11.1 oz / 4 lbs, 5.2 oz

The Series 9 comes with support for Intel's Wireless Display, so you can wirelessly stream 1080p content to a larger HDTV or monitor, provided you pony up $100 or so for the necessary adapter.



We hit our highest auto-overclock with the Gigabyte GA-Z77X-UD5H.

The Asus P8Z77-V excels with bundled Wi-Fi and impressive USB 3.0 speed.

Z77 Showdown

Midrange mobos square off

Not all midrange motherboards are created the same. Sure, these Z77 boards all have a black-and-blue color scheme, and they all carry the exact same street price of $189, but differences emerge when it comes to features, specs, and performance. Which one should you pair with your new 22nm Ivy Bridge CPU? Glad you asked. **–GORDON MAH UNG**

GIGABYTE GA-Z77X-UD5H

Of all the boards here, we're most intimately familiar with Gigabyte's GA-Z77X-UD5H. It's the board we used for the bulk of our Core i7-3770K testing, and one thing we can say is that it's stable. We've literally run more than 50 hours of benchmarks on this board without any issue.

For a sub-$200 board, there are plenty of features, with the most eye-catching being a ton of USB support, including four USB 3.0 ports plus three USB 3.0 headers. This is done using VIA's USB 3.0 controllers plus the new native support from the Intel Z77 chipset. Unfortunately, features didn't trump performance. The Gigabyte was smoked by Asus's super-secret Turbo modes in the benchmarks.

The Gigabyte gets payback by surpassing the two others here in auto-overclocking, hitting 4.5GHz and even offering an unstable 4.68GHz setting. The others topped out on auto at 4.2GHz. The mSATA slot may be the board's most noticeable feature, though, but we're not sure it makes sense on a full-size board. Perhaps if it came with the SSD module; but we don't see any actual advantage to it, particularly since using it disables one SATA port.

Overall, the GA-Z77X-UD5H is a feature-rich mobo for its midrange price. The slot configuration is also nicely balanced, with just one PCI slot instead of two. You get far more I/O and higher auto-overclocks than with the other two boards. Hell, it even comes with probe ports for those of you into the overclocking sports.

VERDICT **8**

Gigabyte GA-Z77X-UD5H

$189 street, www.gigabyte.us

ASUS P8Z77-V

Apparently budget board means legacy support. That's what we inferred from Asus's P8Z77-V board, which has a quaint PS/2 port and not one, but two PCI slots. Don't think that means Asus cheaped out on more modern amenities, though. Although there's no eSATA or FireWire, Asus includes some truly compelling features such as onboard Wi-Fi, an Intel LAN controller, incredibly fast USB 3.0, and a revamped Fan Xpert 2.

What's so exciting about Fan Xpert 2? Plug fans of different makes and speeds into any of the four auxiliary fan headers and the board will automatically measure the minimum and maximum speed of each fan and tune them for you with the most advanced fan-tuning applet we've ever seen from a board maker. If fans don't get you hot, consider the board's USB Turbo mode speeds, which trounce all others by hefty margins.

Like Gigabyte, Asus pushes the Ivy Bridge chip harder than MSI. On Turbo with single- and multi-threaded loads, the Asus hit 3.9GHz. The MSI board was more conservative at 3.7GHz on most workloads.

Overall, we give the nod to the P8Z77-V in this roundup for its performance and useful features, but we can see why someone would prefer the Gigabyte for sheer port madness and eSATA and FireWire needs.

VERDICT **9**

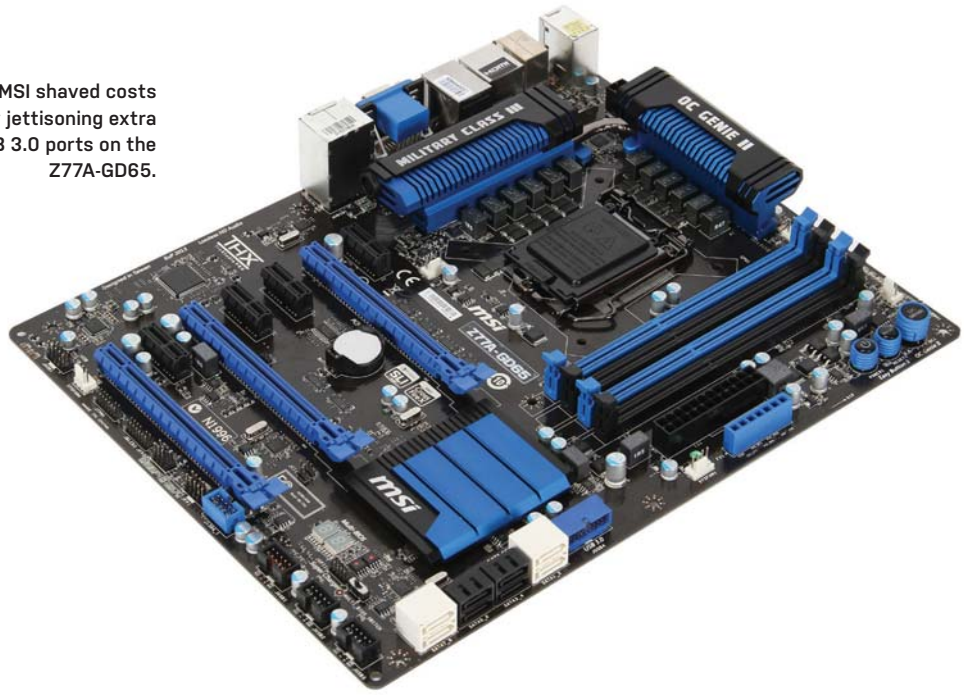
Asus P8Z77-V

$189 street, www.asus.com

MSI Z77A-GD65

Midrange boards typically have to sacrifice features to get under $200 and MSI's Z77A-GD65 shows evidence of this philosophy. It's the only board here without a discrete USB 3.0 controller, instead relying on the native Intel chipset for all USB 3.0. It's also the only board without DisplayPort.

Folks still rolling PCI components will also have to look elsewhere, as MSI ditches the legacy expansion slot for another PCIe slot.



MSI shaved costs by jettisoning extra USB 3.0 ports on the Z77A-GD65.

MSI didn't cut out all the frills, however. The board has onboard power and reset switches, overclocking voltage contacts, an LED POST readout, and, like the two others here, offers both CrossFireX and SLI as well as LucidLogix Virtu support.

In performance, MSI takes the safe road by keeping the clocks lower than the other two boards. At stock speeds, the board topped out at 3.7GHz on multithreaded loads and generally bounced around 3.8GHz with single-threaded loads. The two others here ran full tilt at 3.9GHz on all workloads. Overall, the performance among the trio is generally close.

Like the Gigabyte, MSI's board is obviously intended for Ivy Bridge chips. Why? The last x16 PCIe 3.0 slot only works with an Ivy Bridge. If you intend to run an older Sandy Bridge chip, the slot is deactivated, as SNB doesn't have enough PCIe bandwidth to run it. By sticking with PCIe 2.0 from the peripheral controller hub, the Asus's third x16 is hot no matter which chip you run.

The Z77A-GD65 is a fine board at its price, but yuan for yuan, the Asus and Gigabyte simply outclass it in extra features and specsmanship.

VERDICT **7**

MSI Z77A-GD65

$189 street, www.msi.com

BENCHMARKS

	Gigabyte Z77X-UD5H	Asus P8Z77-V	MSI Z77A-GD65
3DMark 11 Overall	P6,052	**P6,308**	P6,221
PCMark 7 Overall	3,549	**3,739**	3,603
PCMark 7 Lightweight	2,526	**2,755**	2,584
PCMark 7 Productivity	2,387	**2,610**	2,380
Valve Particle (fps)	203	**208**	190
SiSoft Sandra 2012 (GB/s)	21	21.3	20.72
SATA 6Gb/s read (MB/s)	497.9	**509.9**	484.0
SATA 6Gb/s write (MB/s)	230.4	**247.1**	234.0
Native USB 3.0 read (MB/s)	250.2	**429.9**	250.9
Native USB 3.0 write (MB/s)	177.5	**181.3**	177.3
Discrete USB 3.0 read (MB/s)	243.2	**324.5**	N/A
Discrete USB 3.0 write (MB/s)	178.1	**181.8**	N/A
SLI Compliance	Yes	Yes	Yes
32GB Compliance	Yes	Yes	Yes
Auto Overclock	4.5GHz	4.2GHz	4.2GHz

Best scores are bolded. We used a Core i7-3770K, 8GB of DDR3/1866 set at DDR3/1600, a WD Raptor 150, a GeForce GTX 580, and 64-bit Windows 7 Professional in all of our motherboards. SATA 6Gb/s speeds were measured with CrystalDiskMark 3.01 and an OWC Mercury Pro SSD. USB 3.0 speeds were measured with CrystalDiskMark and a Patriot Wildfire SSD in a USB 3.0 enclosure using an ASMedia controller. 32GB compliance was measured with four 8GB DDR3 modules.

Asus GeForce GTX 670 DirectCU II TOP

More power than a stock GTX 680

EVERY GPU generation has its flagship videocards: the ones with the top-of-the-line GPU with all cores enabled, loaded for bear. In this generation, those cards are Nvidia's GTX 680 (with a full GK104 GPU inside) and AMD's Radeon HD 7970 (with a full Tahiti GPU). These cards are monstrously fast, but they're also expensive and tricky to manufacture. Not all parts come off the line fully functional. So a few months after each flagship GPU launch, the vendors come out with a slightly stripped-down version that uses binned top-end GPUs with a few parts disabled, or lower clock speeds. AMD's Radeon HD 7950 (reviewed May 2012), for example, uses the same GPU as the 7970, but with 28 GCN units instead of 32, and with an 800MHz reference clock instead of 925MHz. The cheaper, lower-powered videocards appeal both to gamers with shallower pockets and also to vendors, who clock those stripped-down, less expensive GPUs right back up to within spitting distance of their full-powered peers. Thus we arrive at Asus's GeForce GTX 670 DirectCU II TOP, a factory-overclocked GTX 670 with a custom cooling solution.

Nvidia's reference GeForce GTX 670 uses the Kepler GK104 GPU with one SMX disabled, reducing the total number of CUDA cores to 1,344 from 1,536 and the number of texture units to 112 from 128, and lowering the base and boost clock speeds to 915MHz and 980MHz, respectively.

BENCHMARKS

	Asus GTX 670 DirectCU II TOP	Nvidia GTX 670 Reference	EVGA GTX 680	Sapphire Radeon HD 7950 OC
Price	$430	$400	$500	$400
3DMark 11 Performance	**P9,664**	P8,706	P9,555	P7,683
3DMark 11 Extreme	**X3,300**	X2,957	X3,249	X2,562
3DMark Vantage Performance	**P34,700**	P32,568	P34,339	P31,752
Unigine Heaven 2.5 (fps)	30.7	28.6	**31.2**	26.7
Shogun 2 (fps)	19.4	18.5	18.7	**25.8**
Far Cry 2 / Long (fps)	**110.5**	103.4	107.3	89.6
Dirt 3 (fps)	**73.3**	65.5	73	53.8
HAWX 2 (fps)	**134**	123	131	106
Metro 2033 (fps)	16.7	16	16.3	**18.7**
STALKER: CoP SunShade(fps)	**35.4**	32.4	34.3	34.1
Just Cause 2 (fps)	**57.4**	52.7	54.7	45.3
Batman: Arkham City (fps)	**60**	57	58	54
Base Clock	1,058MHz	915MHz	1,006MHz	900MHz
Boost Clock	1,137MHz	980MHz	1,058MHz	N/A
Memory Clock	1,502MHz	1,502MHz	1,502MHz	1,250MHz

Best scores bolded. Our GPU test bed consists of a stock-clocked Intel Core i7-3960X on an Asus P9X79 Deluxe board with 16GB DDR3/1600, a 256GB Samsung 830 Series boot SSD, and a 1050W Thermaltake Toughpower Grand PSU, in a Cosmos II chassis. All tests performed at 2560x1600 with all settings maxed and 4x MSAA except where noted. Power use measured with a Watts Up Pro.

The reference GTX 670 is a dual-slot card just over 9.5 inches long, although the PCB is less than 7 inches long—the rest is fan shroud. Asus, however, uses an entirely custom PCB and fan shroud. The GeForce GTX 670 DirectCU II TOP, like other DirectCU II cards, uses direct-contact copper heat pipes that feed into a stack of fins under two 8cm fans, all in a spiffy black-and-red shroud. Like the reference card, the Asus board takes two 6-pin PCIe power adapters and has 2GB of GDDR5 frame buffer at 3,004MHz on a 256-bit bus.

To ensure the best overclocks, Asus cherry-picks the best GTX 670 GPUs for the DirectCU II TOP card. The whole assemblage makes the Asus card much heavier and longer than the reference design—the PCB alone is over 9.5 inches long, and the fan shroud makes the card 10.5 inches long, nearly as long as a dual-GPU card.

The extra size and weight pay off, though. The larger fans and greater heat dissipation area mean Asus can push the hand-picked GPU to dizzying speeds. Where the reference GTX 670 has a base clock of 915MHz and a boost clock of 980MHz, Asus's DirectCU II TOP version has a base clock of 1,058MHz (the same speed as the reference GTX 680's boost clock) and a boost clock of 1,137MHz. Asus includes its GPU Tweak software to allow further user overclocking.

We tested the $430 Asus GTX 670 against a $400 reference-design GTX 670, a reference GTX 680 ($500), and a factory-overclocked Sapphire Radeon HD 7950 ($400, reviewed May 2012), its AMD equivalent. As you can see in the benchmark chart, the results are impressive.

At 2560x1600 with all settings maxed and 4x MSAA, the stock GTX 670 outpaces a factory-overclocked Radeon HD 7950 in all but two benchmarks, and gives playable (30-plus) frame rates at these settings in every game except Metro 2033 and Shogun 2. But the impressive performance doesn't stop there. Thanks to those extraordinary factory overclocks, the Asus GTX 670 DirectCU II TOP actually outperforms a reference GTX 680 across the board while being substantially cooler and quieter.

The Asus GTX 670 DirectCU II TOP is large and heavy, but it's quiet, and thanks to the cherry-picked and overclocked processor, it's cooler and faster and has a lower TDP than a stock-clocked GTX 680. If you want top-end performance for less than top-end price, this is your card.

–NATHAN EDWARDS

VERDICT 9 KICK ASS!

Asus GeForce GTX 670 DirectCU II TOP

+ TOP Faster than a GTX 680; cool and quiet; good-looking.

– FLOP Longer and heavier than the reference card; doesn't ship with any cables or connectors.

$430, www.asus.com

The DirectCU II cooler's three direct-contact heat pipes keep the GPU cool.

XFX Radeon HD 7850 Black Edition

Outsized performance from a midrange card

XFX's "Ghost" fan shrouds are easy on the eyes, but they don't vary much from card to card.

THE $250 PRICE point is where the hardcore and the serious gamer part ways. It's not that hardcore gamers aren't serious—it's that they sometimes lose perspective, willing to throw vast, silly sums of money at shiny high-end GPUs. Serious gamers know that a good $250 graphics card will buy you high frame rates on standard, 1080p displays without requiring a second mortgage.

AMD's original MSRP for the Radeon HD 7850 was $250, and you can find a few cards based on the reference design at that price. However, XFX's Black Edition version of the card, which pushes the default 860MHz to a factory-overclocked 975MHz, will set you back a little more. For an extra $20, you get a whopping 13.4 percent overclock for the core frequency, though memory is still clocked at the reference 1,200MHz. But the card ships with a sizeable 2GB of 1,200MHz GDDR5, so it's enough to run games like Shogun 2 with all the detail levels maxed out at 1920x1200 and 4x AA—not possible with the measly 1GB frame buffer on a reference 7850.

The HD 7850 is built on a 28nm process, with 2.8 billion transistors packing 1,024 stream processors and two geometry engines. The reference board requires only one 6-pin power connector, but the XFX board adds a second—that 13 percent overclock doesn't come free.

We compared the Radeon HD 7850 Black Edition's performance with three other factory-overclocked boards: the MSI Radeon HD 6950, EVGA's GTX 560 Ti 448, and the Asus GTX 560 Ti DirectCU II. The EVGA GTX 560 Ti 448 SC card wins most of the benchmarks—but it's $20 more than the 7850 Black Edition, bumping up close to the $300 mark and requiring an 8-pin and 6-pin power plug. The XFX Radeon HD 7850 pretty much wipes the floor with the Asus GTX 560 Ti and the older, more expensive HD 6950. Also, the XFX board is more power efficient, though a tad noisier, than the other boards—but that noise level isn't particularly noticeable in a closed PC chassis.

If XFX could have shaved another $20 off the price of this card, it would have a serious winner on its hands. As it stands, the 7850 Black Edition is a very good card, offering good performance, efficiency, and five display outputs—single- and dual-link DVI, HDMI, and two DisplayPorts. Even a budget gamer might be willing to toss in another $20 for this level of performance. –LOYD CASE

BENCHMARKS

	XFX Radeon HD 7850	Asus GTX 570 DirectCU II	MSI Radeon HD 6950 Twin Frozr III	XFX Radeon HD 6870
Price	$270	$310	$290	$240
3DMark 11 Perf	6,075	5,412	**6,153**	4,782
3DMark Vantage Perf	**24,584**	22,897	23,434	21,278
Unigine Heaven 2.5 (fps)	31	24	**32**	24
Shogun 2 (fps)	47	48	**54**	37
Far Cry 2 / Long (fps)	103	102	**111**	97
HAWX 2 DX11 (fps)	136	101	**155**	129
STALKER: CoP DX11 (fps)	35	36	**37**	33
Just Cause 2 (fps)	**51**	43	**51**	46
Batman: Arkham City (fps)	60	55	**61**	44
Metro 2033 (fps)	**23**	22	22	17
Dirt 3 (fps)	50	52	**65**	55
Core / Memory Clocks	975 / 1,200	850 / 1,300	797 / 975	900 / 1,050
System Power @ idle (W)	**118**	126	133	120
System Power @ full throttle (W)	**248**	273	361	290

Best scores are bolded. Our test bed is a 3.33GHz Core i7 3960X Extreme Edition in an Asus P9X79 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 except for the 3DMark tests and Shogun 2, which was run at 1920x1080, very high, no AA.

VERDICT 8

XFX Radeon HD 7850 Black Edition

+ AVENGERS Solid performance; good efficiency.

– BATMAN AND ROBIN Hard to find; if it were just $20 less....

$270, www.xfxforce.com

SanDisk's Extreme is a plain black metal box with a sticker on it and speed inside.

Solid-State Status Check

So a SandForce and an Indilinx controller walk into a testbed...

Are SSDs approaching commodity status? There are dozens of different consumer SSDs on the market, but with each successive generation it seems there are fewer controllers driving them. This time around the big players are LSI's SandForce SF-2281 controller (found in OCZ's Vertex 3 and Agility 3 drives, Patriot's Pyro SE, Corsair's Force 3 and Force GT, OWC's Mercury Extreme Pro, Intel's 520 Series, and so many more) and Marvell's 9174, found in pretty much everything else. Samsung's 830 Series drives have their own controller, but most of the rest of the market has one of two controllers, differentiated only by firmware and NAND choice. Here we examine two new SSDs: one with an off-the-shelf controller and one with a heavily modified one. **–NATHAN EDWARDS**

SANDISK EXTREME SSD 240GB

SSD vendors that make one or more components of their drives tend to do better than those who just slap commodity parts on a board and call it a day. Sounds reasonable, right? SanDisk's Extreme SSD is yet another drive based on the LSI SandForce SF-2281 controller, a 6Gb/s SATA SSD controller with speedy sequential reads and an emphasis on hyper-fast queued random writes.

However, because it is a NAND manufacturer, SanDisk has the means to use its own 24nm toggle-mode NAND—eight 256Gb packages in the 240GB version—instead of commodity NAND. Like other SF-2281-powered drives, the Extreme SSD uses the extra 16GB of NAND for overprovisioning and write caching.

Contrary to its name, the Extreme SSD isn't very extreme—at least not in the sense of being unusual. It's a good implementation of the SF-2281 controller combined with high-quality NAND, so it's not exactly rare, but that still means it's one of the fastest consumer drives on the planet. With sustained read speeds over 480MB/s and writes around 280MB/s, its performance is what you'd expect from a good SandForce drive—faster than the Intel 520 in reads, slower in writes. Its random performance is classic SandForce territory too—heavily optimized for high-queue-depth 4KB random writes, with over 90,000 IOPS at a queue depth of 32.

There aren't any surprises with the SanDisk Extreme SSD, but that's not a bad thing. It's fast, inexpensive (just over $1/GB at this writing), and based on a proven platform. You really can't go wrong.

VERDICT **8**

SanDisk Extreme SSD 240GB

$250, www.sandisk.com

OCZ VERTEX 4 256GB

OCZ has typically reserved its Vertex label for the highest-performing SSDs in a given generation—using synchronous NAND, for example, rather than the asynchronous NAND found in its less expensive Agility series. The 256GB Vertex 4 carries on that tradition, with 16 128Gb IMFT 25nm synchronous NAND packages on a board with 512MB of DDR3 DRAM cache and OCZ's new Indilinx Everest 2 controller.

It was just a few months ago that OCZ shipped its Octane SSD (reviewed April 2012), which was powered by the first Indilinx Everest controller. Some digging by Anand Lal Shimpi of AnandTech.com revealed that the Everest controller was actually based on Marvell's 9174 controller—the same one used in drives by Plextor, Intel, Crucial, and more, but with custom Indilinx-engineered firmware that allowed the Octane to outperform earlier Marvell-based drives. The Everest 2 controller, while also based on a Marvell one, is aimed even higher.

The Vertex 4's sequential reads, at 440MB/s in CrystalDiskMark and 460MB/s in AS SSD, are impressive, though Samsung's 830 and any number of SandForce-based drives hover closer to 500MB/s. Where the Vertex 4 really stands out, though, is in its write speeds: We saw sustained writes of over 450MB/s, which is absurd—50 percent faster than a SandForce-based SSD. We also saw great results in 4KB read and write performance, both single-queued and heavily threaded. Though not included in our benchmark chart, the Vertex 4's 64-thread 4KB random read and write IOPS (as measured in AS SSD) are over 20,000 IOPS higher than the next-fastest SSDs. Strangely, our Iometer 32QD 4KB random write test didn't show such a strong performance lead. In fact, at 65,000 IOPS, the Vertex 4 was about a third slower than an SF-2281-based drive. Our Iometer test also highlights a potential weakness in the Everest 2 controller: Its maximum response time during our test was a whopping 285ms.

The Everest 2 controller in the Vertex 4 is a modified Marvell controller with custom Indilinx firmware.

That's about eight times the lag we'd see from a SandForce-powered drive, though only about half the 429ms maximum response time on OCZ's Octane drive. Other SSDs based on Marvell controller architecture also have maximum lag times in the 100ms to 500ms range.

Its blazing-fast write performance meant that the Vertex 4 edged out all comers in our Premiere Pro test, albeit by just a few seconds. In PCMark Vantage and 7's storage suites, the Vertex 4 doesn't do quite as well as a SandForce drive, but the differences are minimal.

With an MSRP of $350, the 256GB Vertex 4 isn't as inexpensive as a 240GB SandForce-based SSD, but it's already under $300 on the street, which is pushing close to the magical dollar-per-gigabyte price point. Frankly we can't believe how far SSDs have come in the past year alone.

The Vertex 4's write speeds are truly astounding, and the read speeds are nothing to scoff at, either. We're happy to see OCZ forging its own path with the Everest 2 controller. Even if it's not, strictly speaking, new silicon, the magic firmware sauce is working here.

VERDICT 9

OCZ Vertex 4 256GB

$350, www.ocztechnology.com

BENCHMARKS

	SanDisk Extreme SSD	OCZ Vertex 4	Patriot Pyro SE	OCZ Octane	Samsung 830 Series SSD
Capacity	240GB	256GB	240GB	512GB	256GB
CrystalDiskMark					
Sustained Read (MB/s)	479.1	440.9	482	445.4	**506.4**
Sustained Write (MB/s)	283.7	**446.9**	300.3	315.5	398.5
AS SSD					
Seq. Read (MB/s)	503.8	463	**506.7**	432.2	502.6
Seq. Write (MB/s)	278	**459.3**	295.2	285.9	164.1
4KB Read (IOPS)	5,029	**6,632**	4,986	5,546	5,513
4KB Write (IOPS)	15,244	**17,169**	14,179	10,417	12,800
ATTO					
64KB File Read (MB/s)	**490.3**	396.7	443.24	408.57	405.85
64KB File Write (MB/s)	441.3	470.4	487.9	287.02	**515.05**
Iometer					
4KB Random Write	90,060.8	65,111.06	**91,171.26**	22,073.97	35,329.48
Max Access Time (ms)	**30**	285	41	429	31
Premiere Pro Encode Write (sec)	422	**417**	424	425	420
PCMark Vantage x64 HDD	58,366	41,568	61,686	57,030	**62,168**
PCMark 11 x64 SST	5,282	5,171	**5,305**	4,945	5,257

Best scores are bolded. Our current test bed is a 3.1GHz Core i3-2100 processor on an Asus P8 P67 Pro (B3 chipset) running Windows 7 Professional 64-bit. All tests used onboard 6Gb/s SATA ports with latest Intel drivers.

Zotac ZBox Nano XS AD11 Plus

Small just got smaller

THE BIGGEST thing about Zotac's new ZBox Nano XS AD11 Plus may in fact be its name. This new mini PC is so small, it makes the diminutive ZBox Nano AD10 look positively fat in comparison.

Hell, the only commercial mini PC we've seen that's smaller is the Apple TV, which is about the same width and depth but a quarter-inch thinner. The Apple TV is ARM-based, though, and more in the class of a typical HTPC streaming device. The AD11, with its AMD E-450 APU and 64GB SSD is a full-on PC. While streaming boxes such as WD's Live have come a long way in capability, it's tough to beat a PC's ability to go anywhere you want. From streaming sites that are restricted by cable providers to not-safe-for-work content, an HTPC streaming PC trumps all others if you're willing to live with a mouse and keyboard controls.

The ZBox Nano XS AD11 Plus has two parts that can be swapped: the 64GB mSATA drive and a single 2GB DDR3/1333 SO-DIMM (both of which are easily accessible). Performance of the new AMD E-450 was surprisingly good in our tests. The APU's main new feature is a slight speed bump to its dual CPU cores and higher Turbo clocks for the Radeon HD 6320 core. Performance is only a small factor in an HTPC, but if you want to see the benchies, check out page 65, where we compare the ZBox Nano XS AD11 Plus to this month's Build It rig. In short, the Nano XS AD11 has enough oomph to let us watch streaming HD content on the major streaming services and it could almost tackle that turd known as QuickTime, playing a 1080p trailer from the local drive without dropping frames. For what it's worth, the file plays just fine from Windows Media Player.

Our only negative experience with the AD11 was getting all of the drivers installed. You shouldn't have to play Where's Waldo to accomplish this task, but we had to. There's also a tad bit of fan whine under heavier loads and the USB Wi-Fi fan dongle is uninspired but practical. That doesn't erase the pluses, though. The AD11 is impressively small and capable for what it is. **–GORDON MAH UNG**

VERDICT 9

ZBox Nano XS AD11 Plus

+ ROCKY Small enough to tuck anywhere; has enough power to stream most content.

– IVAN DRAGO Slight fan noise and underwhelming driver-install process.

$360, www.zotac.com

SPECIFICATIONS

CPU	AMD 1.65GHz E-450 dual-core
GPU	Radeon HD 6320
SSD	64GB Lite-On mSATA
RAM	2GB DDR3/1333 single-channel
Ports	HDMI, two USB 2.0, two USB 3.0, one combo eSATA/USB 2.0

Zotac's ZBox Nano XS AD11 Plus is the smallest commercial PC we've ever tested.

D-Link DIR-857 HD Media Router 3000

802.11n's last gasp?

Yes, there are 802.11ac routers on the market, but they're based on Draft 2.0 of the standard, and the Wi-Fi Alliance did not have a certification program in place at press time.

IN CASE YOU'RE wondering why we're reviewing an 802.11n router when the first 802.11ac routers have already reached the market, we have several reasons. First and foremost, the latter didn't make it to the Lab in time for our print deadline. Secondly, the IEEE isn't expected to formally ratify the 802.11ac standard until early 2013. The 802.11ac routers on the market today are based on Draft 2.0 of the standard, so there's a remote chance they could be rendered obsolete when the standard *is* finalized.

D-Link has been oddly quiet about its plans for 802.11ac, but we're guessing the DIR-857 will likely be the company's last consumer-oriented 802.11n model. The DIR-857 is housed in the same low-profile enclosure as the less-expensive DIR-827 we reviewed in May 2012, with a 3x3 antenna array hidden inside and just two discrete status LEDs on top. We understand the "spouse acceptance factor," which requires consumer electronics hardware to be designed to disappear into a home's décor in order to be acceptable to your non-geek significant other, but a flat router with internal antennas just isn't going to perform as well as a vertical model even if they *both* have internal antennas. Pit one of those against any model with external antennas, such as the Asus RT-N66U, and it will fare even more poorly.

That's certainly what we found when we compared the DIR-857 to the RT-N66U: The Asus router, with its semi-vertical orientation and its positional external antennas, crushed the D-Link both in terms of wireless throughput and range. When the client was set up in our acoustically isolated home theater, the RT-N66U delivered more than three times as much throughput, guaranteeing that we'd be able to stream high-definition video to our HDTV without wires. And where the D-Link was barely able to reach the client at our outdoor location, 85 feet from the router, the Asus delivered enough throughput that we'd have no trouble streaming HD video there, too (at least on the 2.4GHz band. The RT-N66U's throughput dropped to 3.9Mb/s on the 5GHz band, but the DIR-857 wasn't able to connect at that location at all at 5GHz).

Since media streaming is such an important application for wireless routers, we've added a new test to our benchmarking suite: We mount a Blu-ray disc image on our notebook PC (from an .iso file stored on our Windows Home Server 2011 machine), and we stream that file across the wireless network. At the same time, we download a large file from the Internet to a second wireless client. Neither router had a problem fulfilling that task at a distance of 45 feet from the router, with an insulated wall, wooden cabinets, and several stainless steel appliances (a refrigerator, a built-in double oven, and a range) in the signal path.

Despite the DIR-857's performance coming up short compared to our new zero-point, we still think it's a very good router. It boasts a rich feature set, including two USB 3.0 ports that made for very fast NAS-to-PC file transfers (it fell far behind the RT-N66U, however, when it came to PC-to-NAS transfers), it has a handy built-in SD card reader, and—as is typical of D-Link routers—it's equipped with excellent Quality of Service settings. It's just not as good as Asus's RT-N66U. –MICHAEL BROWN

VERDICT 8

D-Link DIR-857 HD Media Router 3000

+IPA Excellent QoS features; SD card reader; dual USB 3.0 ports.

–HEFEWEIZEN Relatively short range, especially on the 5GHz band; slow write-to-NAS speed.

$180 street, www.dlink.com

WIRELESS BENCHMARKS

	2.4GHz Band		5GHz Band	
	D-Link DIR-857	Asus RT-N66U	D-Link DIR-857	Asus RT-N66U
Bedroom 1, 10 feet (Mb/s)	112.0	**141.0**	124.0	**152.0**
Kitchen, 20 feet (Mb/s)	73.7	**133.0**	93.2	**129.0**
Patio, 38 feet (Mb/s)	65.3	**110.0**	56.7	**64.1**
Home Theater, 35 feet (Mb/s)	24.6	**77.7**	5.2	**30.1**
Outdoors, 85 feet (Mb/s)	2.7	**50.3**	N/C	**3.9**

WIRED BENCHMARKS

	D-Link DIR-857	Asus RT-N66U
TCP Throughput (Mb/s)	**945.0**	943.0
PC to NAS, small (sec)	78.3	**46.0**
PC to NAS, large (sec)	333.0	**161.7**
NAS to PC, small (sec)	**49.7**	81.3
NAS to PC, large (sec)	**163.7**	280.7

Best scores are bolded. TCP throughput measured using JPerf. NAS tests consist of copying a single 2.79GB file and a folder containing 659MB worth of files and folders to and from a USB 3.0 drive attached to the router. N/C indicates no connection at that location. Additional benchmarking methodology at bit.ly/r5USfH.

Nokia Lumia 900

Makes a strong case for Windows Phone platform

AFTER WAVING the white flag in retreat from American shores against an invasion of iOS and Android smartphones, Nokia has regrouped with the Lumia 900. Now strategic allies with Microsoft's Windows Phone and carrier AT&T, can Nokia stage a comeback and reclaim lost ground?

Nokia has outdone itself with this stylish 5.03x2.7x0.45-inch wide slab, which weighs just 5.6 ounces. It's one of the best-looking smartphones we've ever seen. The Lumia 900 features a classy unibody frame made from polycarbonate. It's tough and feels absolutely wonderful when held in your hand.

The front of the Lumia 900 is primarily a 4.3-inch capacitive touchscreen with an 800x480 resolution. While this can be a sticking point in the age of high-resolution "Retina" displays, the screen is bright, colorful, and pixel-dense enough for all but the most discerning users.

Three capacitive Windows Phone buttons sit below the display for Back, Start, and Search. All the physical buttons—volume rocker, power/lock, and camera button—reside on the right, an arrangement that's quite comfortable in use whether the phone is held in the right or left hand.

The Lumia 900 features a 1MP camera on the front for video chat and an 8MP camera on the back. The 8MP camera shoots 4:3 images up to 3264x2448 pixels, but options are available in settings for 7MP 16:9, 3MP 4:3, and 2MP 16:9, as well. Focus can be switched from Normal to Macro and basic effects can be applied while shooting (Black & White, Sepia, Negative, or Solarize). Contrast and color saturation are above average in most cases, and the Lumia 900 is capable of quite decent outdoor images when the sun is cooperating. We were less enthusiastic about our results shooting indoors, and the dual-LED flash didn't do us any favors, either, producing garish results and a lot of red eye. Results are also quite mixed once you switch the Lumia 900 camera into camcorder mode. With most modern smartphones now recording 1080p HD video, Nokia's newest flagship device appears to bring a knife to a gunfight—it's capable of only 720p HD at 30fps (a less-desirable secondary mode is also available for 640x480 video).

The Lumia 900 runs on a humble single-core Qualcomm APQ8055 + MDM9200 processor clocked at 1.4GHz with a mere 512MB of SDRAM, but don't let the numbers fool you—we were able to flick, tap, and swipe our way through each day without noticeable lag.

AT&T is offering the Nokia Lumia 900 with a modest 16GB of storage for a wallet-friendly $100 with a two-year agreement, but only for a limited time; existing customers can upgrade for a bit more or purchase no-commitment for $450. The big story with AT&T's launch of the Nokia Lumia 900 is 4G LTE. Unfortunately, for the Lumia 900 launch this service is limited to less than 35 cities right now. We had no problem connecting to AT&T's other 4G network—as in its "faux G" HSPA+ wireless capable of up to 21Mb/s download speeds. We didn't hit anywhere near that maximum while testing with the free BandWidth app, but we did hit a respectable 7.05Mb/s download (upload speeds were sadly under 1Mb/s). These are comparable to what we've seen on an iPhone 4S on AT&T, too.

As for the OS, Windows Phone 7.5 remains enjoyable for its refreshingly different tile-centric interface and smooth experience. The biggest downfalls are the relatively paltry app store—currently at 70,000 offerings—and the use of the mobile Internet Explorer 9 for its browser. Render speeds were noticeably slower with IE9, and fonts looked downright chunky when finished. Microsoft does bring one very large bat to this game, however, with the only authentic mobile version of Office. Users can view, create, or edit Word, Excel, and PowerPoint documents as well as OneNote notes on the go and access them from onboard storage, SkyDrive, Office 365, or SharePoint. The app works well, but as usual, making changes to an Excel spreadsheet even on a 4.3-inch display is an exercise in patience.

Nokia has favored form over function with the Lumia 900, which includes a sealed, non-removable 1830mAh battery. Nokia promises up to seven hours of 2G/3G talk time and more than 12 days of standby time, but those figures will vary wildly depending on how many apps you choose to run in the background. We had no problem getting through an entire day with frequent use on both Wi-Fi b/g/n and HSPA+ networks, but your mileage will certainly vary in a 4G LTE market.

If Microsoft and Nokia can tighten up the OS, beef up the Marketplace selection, and slap in a better camera, they'll have a real shot at dethroning one or both smartphone giants. Until then, the Lumia 900 may not be perfect, but it's plenty good enough to recommend with little hesitation for users looking ahead to The Next Big Thing. **–J.R. BOOKWALTER**

SPECIFICATIONS

OS	Windows Phone 7.5 Mango
Processor	1.4GHz Qualcomm APQ8055 + MDM9200
Display	4.3-inch, 800x480, AMOLED
Capacity	16GB storage; 512MB system RAM
Cameras	1MP webcam front; 8MP rear w/ dual-LED flash and autofocus
Video	720p video capture
Connectivity	Wi-Fi, Bluetooth 2.1, 802.11b/g/n, 4G LTE, Micro-USB, 3.5mm audio jack
Battery	Li-ion 1,850mAh
Dimensions	5.03x2.7x0.45 inches, 5.6 oz.

VERDICT 8

Nokia Lumia 900

+ LTE Solid, attractive build; Windows Phone 7; strong app bundle.

– HSPA+ 16GB storage; mediocre camera; paltry Marketplace.

$100 w/ 2-yr contract, $450 w/o contract, www.nokia.com

The polycarbonate body is a pleasure to hold, and the AMOLED screen is bright and colorful.

Each 15-pound cabinet houses a 20-watt Class D amp driving a 1-inch silk-dome tweeter and a 4.5-inch woven-fiberglass woofer.

Aperion Audio Zona Wireless Speaker System

Close enough for jazz

THE PERFORMANCE of Aperion Audio's Zona speakers is good enough for us to grant the company poetic license in labeling these speakers "wireless." They'd need to be battery-powered in order to be entirely free from wires, an impractical solution because those batteries would need to be humongous to power the 20-watt Class D amplifier in each cabinet.

As it stands, each speaker requires a hefty power brick plugged into a power outlet to function (the electrical cables are quite long—17.5 feet—to reach distant outlets). The wireless element comes in the form of a small puck with a USB cable and a 1/8-inch stereo input. Plug the puck into your PC's USB port, and it becomes a USB audio device that takes the computer's PCM audio output and streams it to wireless receivers built into the speakers. The PC powers the puck's wireless transmitter. The Zona is also a great solution for folks who'd like to deploy surround-sound speakers, but can't stomach the idea of stringing speaker cable to the back of the room. In this scenario, you'll connect your A/V receiver's analog pre-amp surround channels to the puck's audio input, and plug its USB cable into the provided AC adapter. Aperion provides all the cables you'll need.

The wireless transmitter and receivers operate on the 2.4GHz frequency band, but we didn't encounter any interference issues even though we have one wireless router and two Wi-Fi access points operating in the house we tested them in (and one of the APs was less than six feet away from the Zona's transmitter). According to Aperion, the system sends an uncompressed bit stream with 16-bit resolution at a sampling rate of 48kHz. That's more than adequate for tracks ripped from CD, but you will lose some fidelity when streaming 24-bit FLAC files or Blu-ray movie soundtracks. We also detected a very small amount of background hiss in the absence of any other audio signal, but only when we put our ear directly against the speaker's grill. If those shortcomings bother you, stick with a wired solution.

Aperion claims the system is capable of 100-foot range, but they're probably not factoring in any walls obstructing the signal path. In our experience, we were able to stream audio from the HTPC in our room-within-a-room home theater to any other room in our 2,700-square-foot house, but we encountered audible dropouts at the fringes when we blocked a speaker with our body. Perhaps more importantly, we didn't detect any audible lag when we set up the speakers as surround channels *within* our home theater.

Listening to Cara Dillon's rendition of the Irish folk song "The Parting Glass," from the Bowers & Wilkins' release *Live at the Grand Opera House* (encoded in 24-bit FLAC at a 48kHz sampling rate), it was easy to forget that the music was streaming over the airwaves. The speakers delivered a solid performance with crisp highs and a fat bottom end; and while the loss in fidelity from down-sampling was noticeable, it wasn't particularly irksome. Given the choice, we'll always take the no-compromises wired solution. But if that's not an option for you, Aperion Audio offers an excellent alternative in the Zona Wireless Speaker System. –MICHAEL BROWN

VERDICT 8

Aperion Audio Zona Wireless Speaker System

+ IN THE ZONE Very good sound; uncompressed wireless streaming; can be mounted.

– ZONED OUT You'll need to hide the large power bricks; range shorter than advertised.

$400, www.aperionaudio.com

Cooler Master TPC 812

Vertical vapor chamber—blowing hot air?

Those massive heat pipes protruding from the top of the cooler? They're decorative caps, sitting on the real (and smaller) heat pipes.

WE HAVE BEEN anxious to test Cooler Master's TPC 812 since we saw a prototype at this year's CES—or was it last year's? Regardless, the company piqued our interest with its talk of "vertical vapor chamber cooling," and we finally have our hands on the TPC 812, a massive air cooler with six heat pipes and two vertical vapor chambers.

The TPC 812 is 6.4 inches high, 4.1 inches deep (with fan), and 5.4 inches wide, and weighs over two pounds, four ounces. Unlike Cooler Master's wildly successful Hyper 212 coolers, the TPC 812 doesn't have direct-contact heat pipes. Or direct-contact vapor chambers. Instead, its six heat pipes are soldered to the (nickel-coated) copper heatsink, and the bottoms of the vapor chambers rest atop the heat pipes. The heat pipes and vapor chambers rise through a large stack of aluminum fins. The TPC 812 ships with one 12cm PWM fan with a set of plastic mounting clips, beefier versions of the ones that ship with the Hyper 212 Evo (April 2012), as well as a set of clips for attaching an additional fan. The cooler also ships with a resistor cable if you prefer to run your fan at lower rpms, which you might, given its noise at full throttle.

The TPC 812 mounts to the motherboard with the same sort of mounting bracket we've seen on the Hyper 212 series coolers: an X-shaped crossbar with spring-screws at the ends, which mounts to four posts in the motherboard's cooler mounting holes. The posts are either screwed directly into the integrated backplate (LGA2011) or into a universal backplate (all other sockets).

The TPC 812 cooled our overclocked i7-3960X to 71.2 C—47.2 C above the 24 C ambient temperature in the room. By contrast, the Xigmatek Aegir, our champion at this price/size range, got the CPU down to 69.2 C in a 25.6 C room (43.6 C difference), and the CM Hyper 212 Evo, our favorite budget cooler, got the CPU to 70.2 C while the room was 25.7 C (44.5 C difference). The TPC 812 isn't a bad cooler—its performance is still impressive. It's just not enough to dethrone the Hyper 212 Evo or the Xigmatek Aegir. Both, incidentally, are direct-contact coolers, and the Evo is half the price of the TPC 812.

We're not sure why Cooler Master chose to use vapor chambers at all on this cooler, given that a vapor chamber is essentially a wide, flat heat pipe. They're useful in space-constrained applications like videocards, but the TPC 812 hardly has that problem, and putting vapor chambers atop the six heat pipes the cooler already has feels like an afterthought, or a gimmick.

Given that this is the only vertical vapor chamber cooler we've tested, we're not ready to dismiss the technology outright, and the TPC 812 is a fine cooler, but compared to cheaper, lighter direct-contact coolers, the TPC 812 can't win.

–NATHAN EDWARDS

VERDICT 8

Cooler Master TPC 812

+ CHAMBER OF SECRETS Good looks; relatively easy install; decent performance.

– BLACK CHAMBER Performance lags behind best-in-class, which are smaller and cheaper; noisy fan.

$70, www.coolermaster-usa.com

SPECIFICATIONS

Dimensions H x D x W (inches, with fan)	6.4 x 4.1 x 5.4
Weight	2 lbs, 4.6 oz
Heat Pipes	6, plus two vertical vapor chambers
Stock Fans	1x 12cm
Add'l Fan Support	1 (plastic clips included)

BENCHMARKS

	CM TPC 812	Xigmatek Aegir	CM Hyper 212 Evo
Ambient Air	24	25.6	25.7
Idle Temperature	32.3	34.2	34.2
Burn Temperature	71.2	**69.2**	70.2
ΔT (Burn-Ambient)	47.2	**43.6**	44.5

All temperatures in degrees Celsius. Best scores bolded. All tests performed using an Intel Core i7-3960X at 4.2GHz, on an Asus Sabertooth X79 motherboard with 16GB DDR3/1600, in a Thermaltake Level 10 GT with stock fans set to Low.

If this isn't a tease of Diablo III's expansion, we'll eat our rare Wizard hats.

Diablo III

This took 11 years?

LIKE MANY OF THE one-sided NPCs that appear within Blizzard's third summer-vacation-to-Hell, it sure feels as if there's something special lurking beneath Diablo III—once you get behind all the odd trappings and poor design decisions, that is. If you're new to the series, the game goes something like this: See evil, click on evil, kill evil. Repeat 100,000 times. That's Diablo.

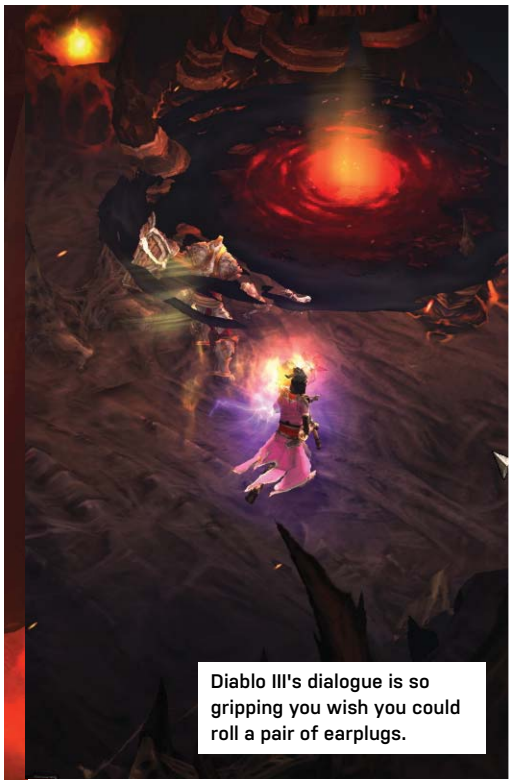
Diablo III beautifies this formula by combining artistic flair with rote gameplay. Spell effects and weapons glow or *boom* with real pizzazz, and the environments—though not as gritty as in the original Diablo—are themed with more eye candy and interaction than ever before. That includes everything from the gross, blood-spurting torture instruments that you can shatter in the Halls of Agony, to the giant chained demons "looking" up at you in the background of the Tower of the Damned, to the epic human-on-demon fighting you see on the ground (and *eventually* participate in) while fighting atop Bastion's Keep.

While the game still features a bit of the genre's "evil stands around and waits for us to kill it" motif, Blizzard's done a great job of incorporating more surprise into Hell's troop deployments. Baddies scale walls, "Demonic Hell Bearers" surge over walls, Dune-like sandworms pop through the ground to say hello, and demons fly with bullet-like speed up into Heaven itself (and then start swinging). Blizzard's creative use of the environment adds more depth and realism than anything you've ever seen in the Diablo series to date; we smile each time we get to cut a chandelier cord and wonk a skeleton in the noggin'.

A special kudos to Blizzard for making Diablo III the most challenging of the Diablo games. There are plenty of times when a seemingly normal situation turns into a "mash all the buttons" encounter of deadly proportions. This is not a game where you'll be able to clean up every trash mob until the boss without breaking a sweat. Painful, randomized affixes added to the game's elite mobs can ruin your day, but so can the normal baddies if you're not thinking strategically about how you might fight them. Gamers will grow a great hatred in their hearts for the (damned) Sand Wasps of Act II: truly, Blizzard's most insidious creation and the grand masons of many a hardcore character's tombstone.

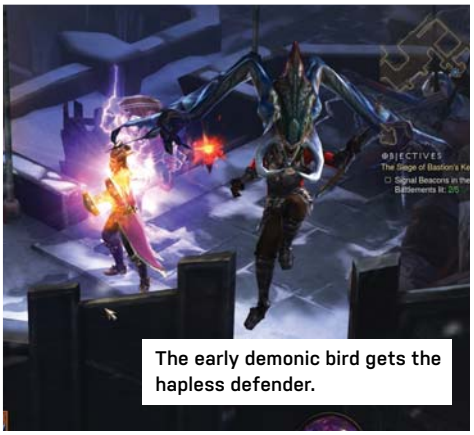
However, one of the big issues plaguing Diablo III is that the game's difficulty doesn't scale all that well—at least, not in the correct way. The game's boss encounters are inconsistent, ranging from painfully simple encounters to semi-strategic fights that exemplify World of Warcraft's first rule: Don't stand in the glowing stuff. That's all well and good, but it's not all that innovative. Even when done well, Blizzard's treatment of its major bad guys (and gals) still doesn't feel all that creative compared to the fight mechanics of Diablo's MMO cousin. Diablo III needs more depth.

Across the game's four difficulty levels, Blizzard generally makes Diablo III harder by increasing enemy hit points and damage, not by forcing the player to outthink mobs or bosses. The actual mechanics of the final Diablo fight are identical on the game's hardest difficulty and its easiest:



Diablo III's dialogue is so gripping you wish you could roll a pair of earplugs.

Oh, had one a nickel for every time a demon or angel calls you "Nephalem" while shaking its head in disapproval...



The early demonic bird gets the hapless defender.

It'll just take you a lot longer on "Inferno," hurt a lot more, and you'll be frustrated as all heck when you're unfairly one-shotted by the game's many mobs along the way.

"But wait," you say, "Diablo III's skill system means you can pick the perfect combination of six spells on-the-fly to manage any battle!"

True. But Blizzard's approach doesn't expand your ability to customize your character; it limits it. A specific range of spells and gear gives a player enough survivability to perform the ultimate exploit on the game's highest difficulty: kiting super-charged bad guys around in a circle and killing them slowly over time. That's not using a range of spells or creative character builds *strategically* to dodge, reflect, resist, or otherwise participate in what we'd call "active combat." It's a passive and downright boring technique players have to use against enemies who can obliterate them with a single hit.

Blizzard has transformed its difficulty settings into gear checks, not engaging challenges that can be surpassed by a mastery of *technique.* Harder difficulties should make monsters smarter and showcase new and exciting boss mechanics players haven't seen before. Don't just give each demon a Golden Gun.

"Shut up and gear up," some might retort. Well, Blizzard's made that surprisingly easy with Diablo III's new in-game auction house, which does a great disservice to the entire premise of the Diablo series. Part of the joy of Diablo II's end game came from going on countless "boss runs" to acquire better gear. If you were unlucky, however, you had to take the unwanted gear you picked up and trade it away to your peers for better loot.

In contrast, Diablo III's auction house hurts the game's replay value. Why bother running levels over and over to hunt for new gear when you can just take all the gold you picked up and buy the perfect item you're looking for? There's no need to use the game's "Jeweler" crafting NPC when you can spend less gold to buy better gems from players; same for the Blacksmith NPC. Why create items with random stats when you can buy exactly what you want from the millions of players selling? And don't get me started on Diablo III's general itemization. At the time of this review, blues (magic weapons, easily found) can offer better stats for your end-game character than Blizzard's super-unique Legendary items. Huh?

You can't take much solace in Diablo III's woeful story. The Diablo series isn't exactly *War and Peace*, but the plot elements within Diablo III's acts feel more like short vignettes than a truly connected through line. It's hard to feel much of an emotional connection from the game's laughably poor dialogue and dreadful story arcs, and the obviousness of Diablo's "intricate" plot is as transparent as an archangel's energy wing tentacle-things. As for why Blizzard made The Butcher the end boss of Act One—a throwaway homage to its first game that has no connection to the plot whatsoever—has us scratching our heads.

The silly decisions continue. It makes no sense why Hell's greatest planner whines more than schemes; why an arch-mage whose entire storyline centers on his immortality turns into one of the easiest boss fights in the game (some invulnerability); and why Diablo itself somehow feels the need to taunt you like a playground bully every time you kill one of his friends. The "Lord of Terror" was a lot creepier when he threatened you with death the first (and last) time you saw him in previous titles. Pouty Diablo is a joke.

If we sound mad, we're not. The core mechanics of Diablo III truly are fun. You will enjoy leveling up, swapping skills left and right, and shooting demons with reckless abandon. The game is pretty on the eyes (especially those jaw-dropping cutscenes), fairly interactive, and much faster-paced and friend-focused than Diablo II. But the hard truths remain: For a game that sat in development for so long, Blizzard's tunnel vision seems to have significantly affected its ability to transform a pretty good romp into Hell into a legendary sequel. It's a shame, too; what gamer wants to wait 10 more years for a better Diablo IV? –DAVID MURPHY

VERDICT 7

Diablo III

WIRT THE PEG-LEGGED BOY Addictive gameplay, beautiful graphics, and challenging scenarios will keep you thinkin' and clickin' for a while.

GHARBAD THE WEAK Poor plot decisions, ill-conceived enemy mechanics, and the dreadful auction house cheapen Diablo's *raison d'être.*

$60, www.diablo3.com, ESRB: M

LAB NOTES

ALEX CASTLE **ONLINE MANAGING EDITOR**

It's Not Goodbye, It's Aloha

Editor leaves Lab for island paradise

SADLY, THIS ISSUE is my last as a full-time editor at the *Maximum PC* offices in San Francisco. Don't shed too many tears for me, though; I'm now living in (and will be contributing to the magazine and website from) Hawai'i, the nation's southernmost and most island-ular state.

Since announcing this fact on the website, a lot of people have asked why an online editor even needs to be in the office. The fact is, even with all the advances in telepresence tech, there are still things that make remote work impractical. Working in different time zones can be a pain, as is shipping products for review and dealing with state tax law. But the most important thing is that making a magazine is a complicated business, and not having all the moving pieces in the same location only makes it more complicated. I'll miss being a staffer at *Maximum PC*, but I can't wait to see what great stuff the magazine has in store.

Gordon Mah Ung
Deputy Editor

I know dual-core desktop Ivy Bridge chips will bring the power down to as low as 35 watts, but I'd actually like to see a resurgence of even lower-wattage builds using mobile chips. That 35 watts would net you a quad-core instead of a dual-core if a mobile Ivy Bridge chip was used, and a dual-core can take you as low as 17 watts.

Katherine Stevenson
Editor-in-Chief

Can an 11-inch notebook deliver a kick-ass gaming experience? I was pleasantly surprised with the oomph in Alienware's M11x a couple of years back, but Dell has since eliminated that small form factor from its lineup, presumably due to lack of sales. Nevertheless, other vendors are stepping into the 11-inch gaming-notebook fray, and I'll be reviewing one of those portable powerhouses next month.

Nathan Edwards
Senior Editor

I've gotten some flak over starting our Blueprints section with a $1,300 rig. After all, a console is $300 and we've built plenty of decent sub-$1,000 gaming machines. My original rationale was that "Baseline" really means "the base power-user PC we'd be absolutely proud to recommend." But should we have a sub-$1,000 Blueprints build too? Let me know at nathan@maximumpc.com.

Richard Koscher
Art Director

My recent trip to the WPA Maggie Awards in Los Angeles was a successful one. Not only did *Maximum PC* pick up an award for Best Special Interest Magazine, but it also took the grand prize for Best Overall Consumer Magazine from a crowd of 1,400 entries. The judges based their decision on our September 2011 Dream Machine issue. It's great to be recognized by the leaders of the publishing industry for all the hard work we pour into our magazine.

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Random Upgrades
> AHCI Hack
> Cyborg Cases

Too Many Upgrades, and AMD

First, can and will the heads of the computer industry agree to release upgrades as a platform instead of the randomness seen today? Meaning, will they agree to release USB 4.0 or SATA 4.0 *only* when PCIE 4.0 and DDR4 are ready to go? Second, from what I have read, Bulldozer is an inferior-performing chip. AMD promises better performance on Windows 8, but what if that doesn't happen? Since AMD already had to lay off workers, will Bulldozer spell the end of the company or at the very least its desktop chips? If AMD is forced to close, will IBM make a grab at it and re-enter the desktop market?

—Brad Davis

DEPUTY EDITOR GORDON MAH UNG RESPONDS: The main problem with your first question involves the differing cadences of each technology. It would actually hurt the industry as a whole, not to mention performance, if each different technology had to wait for another before it could launch. This doesn't mean synchronicity doesn't happen, though. Sometimes new technology launches are so close they intentionally sync up to reduce the pain of adoption and to make an upgrade sweeter. Another problem with so many different technologies launching at once is that oftentimes there is so much money at stake in a spec and so much politics that it takes months just to agree on the shape of the table to meet around.

As for Bulldozer, performance on Windows 8 will likely get better, but not magically faster than Intel's parts. That doesn't spell the end of the company, however. AMD is seeing good success with its integrated Brazos, Llano, and Trinity parts. AMD's future never hinged solely on Bulldozer beating Intel's parts in performance. And no, IBM is unlikely to ever get back into the desktop market making traditional x86 PCs.

Let's Be Real about Mobile Gaming

I recently read Alex Castle's "PlayStation Vita vs. iPhone 4S". in the Head to Head section (June 2012) and came away a bit confused. At the end, he declares the Vita the winner, stating, "the PlayStation Vita is simply the best way to play real, high-quality games while you're away from home." I must have missed the memo that declared Minecraft, Need for Speed, Dead Space, RAGE, Doom, Mass Effect, Sonic, Soul Calibur, and Final Fantasy (among many, many others) as not being "real" games. You learn something new every day.

—Ed Piotrowski

ONLINE MANAGING EDITOR ALEX CASTLE RESPONDS: Having played nearly all the games you've mentioned, I have to assume that either you *have not*, or that you're being deceptive to make a point. Although all the titles mentioned share a name with classic gaming franchises, none of them is the type of gameplay experience normally associated with games from their brand. Need for Speed is probably the closest, but it still lacks the depth of a full NFS game (or other quality racing games, such as Wipeout 2048 for the PlayStation Vita). RAGE looks phenomenal on the Retina display, but it—like Dead Space—has been reduced to an on-rails shooting gallery. Sonic and Soul Calibur are both crippled by less precise, less responsive controls. I could go on, but I hope you get my point: I love the iPhone for gaming, but it's

CUT, COPY, PASTE

→ In our July issue LCD roundup, we used the wrong picture to illustrate the Samsung Series 5 T27A550. The correct model is pictured here.

→ Two of the zero-point scores in the benchmark chart for the Origin PC Chronos (June 2012) were incorrect. The Chronos was actually 11 percent faster than our zero-point in Vegas Pro, and just 2 percent slower than our zero-point in STALKER: CoP.

↘ submit your questions to: comments@maximumpc.com

> AMD'S FUTURE NEVER HINGED SOLELY ON BULLDOZER

at its best with games that embrace the limitations of the form factor, rather than pretend they don't exist.

You Forgot to Hack in AHCI

In the July 2012 "Operation Upgrade" article, one of the "DOs" of upgrading was to make the jump to AHCI. In that little tip, you said Windows 7 will fail to boot if you don't switch to AHCI during a clean install. However, you can get around this by editing the registry. You go to HKEY_LOCAL_MACHINE/SYSTEM/CurrentControlSet/services/msahci. Change value of Start to "0," and AHCI will work.

—Calvin Ho

Deputy Editor Gordon Mah Ung responds: Agreed, Calvin. I've used that registry change myself with success and should have offered that as an option for those who wish to enable AHCI after the fact.

I Don't Want to Be Assimilated!

I moved to China for a few years after graduating from university, and I'm plotting a new build when I go back to visit the States. I love over-the-top features and front-panel connectors, but it seems like every case out there has some weird Borg-looking accents or futuristic pyramids protruding from the sides or top. I hate gaudy, neon-lit giant towers! Is there a case with every bell and whistle that isn't a fugly piece of hideous plastic cyborg crap?! Can I just find a cube-looking thing that I can put stuff in?

—Nathan Willingham

SENIOR CASE WRANGLER NATHAN EDWARDS RESPONDS: I feel your pain! We have a new case roundup coming next month which will have a few cases (like the Silverstone TJ-04E and Corsair 550D) that might be up your alley. We also like the Fractal Design Define R3, NZXT H2, and Antec P280, as far as clean-looking modern chassis go. In general, Silverstone and Lian Li trend toward the clean aesthetic you're looking for. On the less expensive side, so do BitFenix, Fractal, and Cubitek.

Win8 Partition Remnants

On Page 24 of the June 2012 issue (second paragraph, last sentence) David Murphy states that if you install Win8 in dual-boot mode using a newly created partition, you will not be able to undo this. Can't you delete the Win8 partition and put the hard drive back to the way it was before partitioning?

—Howard Rosen

WINDOWS 8 GURU DAVID MURPHY RESPONDS: Yes, you can delete the Windows 8 partition to "remove" Windows 8 from your system. However, the Windows 8 bootloader will remain—a shadowy reminder of the operating system you killed. That's what I meant by the comment, as it's a wee bit trickier to restore the bootloader back to your Windows 7 version (for example), and just wiping the partition clean without first setting the bootloader back to Windows 7's (using the Windows 7 Repair function on the DVD) could lead to unfortunate results.

[NOW ONLINE]

THE NOW-MONTHLY MAXIMUM PC PODCAST

After a period of inactivity (caused by a caustic chemical spill at the Maximum PC Podcast Refinery), everyone's favorite tech talk show is back on the air. Keep your eye on our podcast directory at bit.ly/ldy1 for a once-a-month dose of tech news, analysis, listener calls, and a generous helping of off-topic rambling!

[NEXT MONTH]

COMING IN MAXIMUM PC'S

OPTIMIZED FOR MULTI-THREADING SEPTEMBER ISSUE

Dream Machine 2012

Warning: Our annual confluence of badass hardware into an even badder-ass rig is known to cause heart palpitations and extreme PC envy.

Mid-Tower Mayhem

Our roundup of six mid-size enclosures was delayed to make room for the GTX 690, but next month you'll get the full scoop on which cases make the cut.

File Recovery Roundup

When disaster strikes and you find that your valuable data has been lost or corrupted, you'll want to know which file/disk recovery software can save the day.

THE BUILDS

BASELINE

INGREDIENTS

PART		URL
Case	Fractal Design Define R3	www.fractal-design.com
PSU	Corsair TX750 V2	www.corsair.com
Mobo	Asus P8Z77-V	www.asus.com
CPU	Intel Core i5-3570K @3.4GHz	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	www.samsung.com
Solid-State Drive	OCZ Agility 3 120GB	www.ocztechnology.com
Hard Drive	Seagate Barracuda 3TB	www.seagate.com
OS	Windows 7 Home Premium 64-bit	www.microsoft.com

Approximate Price: $1,340

NOW THAT we've reviewed some Ivy Bridge motherboards (see page 72), we feel comfortable making a recommendation: the Asus P8Z77-V, with the new Core i5-3570K. And now that hard drive prices have dropped, we've gone for a faster, bigger HDD.

We've had some readers ask why our Baseline rig costs over $1,300. Maybe baseline is the wrong word—this is a no-BS, sweet-spot gaming machine that's forward-compatible and powerful without being overkill. We can, and do, build sub-$1,000 (and sub-$700) gaming rigs, but they require compromise due to budget constraints. The Baseline doesn't.

PERFORMANCE

INGREDIENTS

PART		URL
Case	NZXT Phantom 410	www.nzxt.com
PSU	Corsair HX850	www.corsair.com
Mobo	Asus Sabertooth X79	www.asus.com
CPU	Intel i7-3820 @4.7GHz (overclocked)	www.intel.com
Cooler	NZXT Havik 120	wwww.nzxt.com
GPU	Asus GTX 670 DirectCU II TOP	www.asus.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: $1,870

OUR BASELINE is everything you need for high-resolution, high-quality gaming. Full stop. But if you add an extra $500 to your budget, you get more stuff: eight processor threads instead of four, eight RAM slots, and an upgrade path to a six-core CPU down the line. You also get a Blu-ray burner and one of the fastest GPUs we've ever tested. This Sandy Bridge-E rig has remained mostly the same since it debuted in June, except for the videocard—and the price. We're now recommending Asus's GTX 670 DirectCU II TOP (page 74), which outperforms a stock GTX 680 on all of our benchmarks, while being $70 cheaper.

ULTRA

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 a step below Dream Machine. So it's merely absurd, not absolutely over the top. Speaking of which: Dream Machine is next month!

The price of our Ultra configuration is down to just (!) $3,460, thanks mostly to GPU price drops. Instead of two Radeon HD 7970s, we're recommending a GTX 690. If you're going to have two $500 GPUs in one machine, you might as well put them on the same card and save some room and some power.

Intel's Core i7-3930K is $570 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.

Cooler Master's Cosmos II case is huge and luxurious, with plenty of airflow to cool everything, and the Asus motherboard is great for overclocking and will hold another GTX 690 if you go absolutely out of your gourd for power. We're keeping the 256GB Samsung 830 SSD and 6TB of speedy mass storage.

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 (overclocked)	www.intel.com
Cooler	Corsair H100	www.corsair.com
GPU	EVGA GTX 690	www.evga.com
RAM	16GB Corsair Vengeance DDR3/1600	www.corsair.com
Optical Drive	LG WH12LS39 BD-R burner	www.lg.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: $3,460

SUGGESTED PAIRINGS

Kick-ass peripherals for your new rig

MIDRANGE MONITOR
Asus PA238Q
$300, ww.asus.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

MAXIMUM PC (ISSN 1522-4279) is published 13 times a year, monthly plus Holiday issue following December issue by Future US, Inc., 4000 Shoreline Court, Suite 400, South San Francisco, CA 94080. Phone: (650) 872-1642. Fax: (650) 872-2207. Website: www.futureus.com. Periodicals postage paid in San Bruno, CA and at additional mailing offices. Newsstand distribution is handled by Time Warner Retail. Basic subscription rates: one year (12 issues) US: $14.95; Canada: US$19.95; Foreign: US$29.95. Canadian and foreign orders must be prepaid. Canadian price includes postage and GST (GST #R128220688). PMA #40612608. Subscriptions do not include newsstand specials. POSTMASTER: Send changes of address to Maximum PC, PO Box 5852, Harlan, IA 51593-1352. Standard Mail enclosure in the following editions: None. Ride-Along enclosure in the following editions: None. Returns: Pitney Bowes, PO Box 25542, London, ON N6C 6B2, Canada. Future US, Inc. also publishes @Gamer, Crochet Today!, Your Knitting Life, MacLife, Nintendo Power, The Official Xbox Magazine, PlayStation: The Official Magazine, PC Gamer, and Windows: The Official Magazine.