

20 Years of Technology – Product Match-up

1988 vs. 2008: A Tech Retrospective

By Becky Waring, PC World

Think the iPhone is pricey? The cool cell phone of 1988 cost \$4,382 in today's dollars. A 150MB hard drive? \$8,755. Take a trip with us down memory lane and you'll never whine about the price of a gadget again.

Ever wax nostalgic about your first PC or cell phone? It's easy to forgive your Tandy desktop or your Motorola portable for their limitations -- after all, they were technological infants.

What we often forget, though, is how \$%#@! expensive that crude neolithic junk was! So join us on a trip two decades back in technology's history -- and we bet that the next time you're charged \$895 for a small square of plastic and transistors, you'll smile and say, "Wow, what a bargain!"

Home Desktop PCs



1988: Tandy 1000 TL

- **Price:** \$1,400 (\$2,454 adjusted for inflation)
- **CPU:** Intel 80286
- **RAM:** 640KB
- **Storage:** 3.5-inch floppy
- **Monitor:** 14-inch, 640-by-200 RGB CRT, 16 colors



2008: HP Pavilion Elite m9100z series

- **Price:** about \$1,000
- **CPU:** 2.8-GHz AMD Athlon 64 X2 5600+ dual-core

- **RAM:** 2GB
- **Storage:** 750GB HD, CD/DVD recorder
- **Monitor:** 17-inch, 1440-by-900 LCD, 16.7 million colors

By 1988, personal computers had found their way into about [15 percent of U.S. households](#). PCs dominated, but [other home systems were popular as well](#) -- among them the Apple II, Macintosh, Commodore 64, Atari ST and Amiga 2000.

PCs came with DOS; Windows 2.0 was a \$99 option, and one of many competing graphical interfaces. Radio Shack was home PC central, offering the [Tandy 1000 TL](#) for \$1,400 in a configuration that included a 14-inch, 16-color monitor; 640KB of RAM; and a single 3.5-inch floppy drive.

Tandy's DeskMate graphical interface provided an office suite, drawing and sound-editing apps and PC-Link online software, a precursor to AOL. The 16-color monitor, graphical OS and multimedia support were cutting-edge in an era still dominated by monochrome monitors and DOS. But the \$1,400 price didn't cover a mouse, a modem, a network card, or a hard drive, each of which was an expensive add-on. And CD-ROM drives were extremely rare. Microsoft had just released the first version of [Bookshelf](#), a collection of reference materials on CD-ROM in September 1987, and it would be another couple years before the CD-ROM format really took off.

The situation in 2008 almost defies comparison with 1988. Instead of conserving RAM and disk space like gold, we store our entire lives on our hard drives and expect our PCs to double as home entertainment centers. For a total price of \$1,000, the [HP Pavilion Elite m9100z](#) is available with Vista Home Premium, a 750GB hard drive, an HDMI graphics card, Wi-Fi, a CD/DVD recorder, an HDTV tuner, surround sound, and a 17-inch flat-panel monitor.

Where do we go from here? Expect connected everything -- from lights to washers to talking mirrors to fridges that make your grocery lists. Instead of a home computer, we'll have a computerized home.

Laptop PCs



1988:Toshiba T1200H

- **Price:** \$4,098 (\$7,182 adjusted for inflation)
- **CPU:** 4.77-/9.54-MHz Intel 80C86
- **RAM:** 1MB
- **Storage:** 20MB hard drive, 720KB floppy drive
- **Display:** 9.4-inch supertwist LCD
- **Weight:** 14 pounds (including modem, charger, and case)

- **Battery life:** 2 hours



2008:Lenovo ThinkPad X61

- **Price:** \$1,724
- **CPU:** 2-GHz Intel Core 2 Duo T7300
- **RAM:** 2GB
- **Storage:** 160GB HD, PC Card slot, SD Card slot, external CD/DVD recorder
- **Display:** 12.1-inch 1024-by-768 LCD, 16.7 million colors
- **Weight:** 3.6 pounds (6.1 pounds including adapter, ultrabase, and DVD burner)
- **Battery life:** 6 hours

Laptops in Toshiba's T1200 series ranked among the most popular of their day, combining very good portability, performance and value, and were warmly recommended in many reviews, including *PC Worlds*. Of course the definition of a "laptop" is different now, and a model that weighed 14 pounds including essential accessories such as a modem and charger would be a nonstarter -- or a desktop -- today.

That said, LCD laptops represented a major advance in size and weight over the CRT suitcase models that Compaq pioneered. The T1200H was doubly impressive for its 20MB hard drive -- a major expense and weight in those days. Adding a 2400-baud modem would cost you another \$400 or so.

How have things changed? Well, to start with, you could fit three ThinkPad X61 laptops into the same space that the Toshiba occupied, and you could run any one of those ThinkPads three times longer and many times faster than the T1200H could go. And if you did buy three ThinkPads, you still wouldn't have spent as much as you did on the Toshiba in 1988.

The future trend in portables is to get smaller and thinner, thanks to shrinking component sizes. But you can go only so low with a full-size screen and keyboard, so look for [fold-up screens](#) and keyboards that eliminate these size constraints.

Hard Drives



1988: 150MB Core HC150

- **Price:** \$4,995 (\$8,755 adjusted for inflation)
- **Cost per MB:** \$33 (\$58 adjusted)
- **Seek time:** 17ms
- **Controller:** ESDI (\$495)
- **Data Transfer rate:** 1.25 mbps
- **Heads/Disks:** 9/5
- **Expected life:** 50,000 hours



2008: 1TB Seagate Barracuda 7200.11

- **Price:** \$363
- **Cost per MB:** \$0.000363
- **Seek time:** 9 milliseconds
- **Controller:** SATA 3Gbps
- **Data Transfer rate:** 300 mbps
- **Heads/Disks:** eight/four
- **Expected life:** 750,000 hours

Hey, want to buy a 1-terabyte hard drive for \$5.8 million? We thought not. But based on per-megabyte prices in 1988, that's how much a 1TB drive would have cost in 2008 dollars.

By contrast, today's top-of-the-line [1TB Seagate Barracuda 7200.11](#) is one of the fastest drives around and dirt-cheap at just \$363. Back in 1988, of course, we didn't have scads of 10-megapixel photos and high-definition video cluttering up our drives, much less entire music libraries. (You can fit about 2,500 CDs on a 1TB drive in lossless format, and far more as compressed MP3 files.)

Hard drives perfectly exemplify the law that content expands to occupy available space. In the future, we'll probably continue to fill up every [yottabyte](#) and [gibibyte](#) that the storage gods bestow on us, even if we have to get a Ph.D. in units of measure to comprehend the volume of space available to us.

But the true game-changer in storage is no longer capacity; it's size. Ever-tinier flash drives provide the data needed for powerful handheld devices, from cameras and smart phones to media players.

Color Printers



1988: AlpsALQ300

- **Price:** \$995 (\$1,744 adjusted for inflation)
- **Printhead:** 24-pin color dot-matrix
- **Speed:** 31 seconds/page in letter-quality mode, up to 10 minutes/page for color graphics
- **Interface:** Serial



2008: Canon Pixma iP3500

- **Price:** \$80
- **Printhead:** 4800-by-1200-dpi color, 1,600 nozzles
- **Speed:** as fast as 3.5 seconds/page in color
- **Interface:** USB 2.0 and PictBridge

The Alps ALQ300 was a much-sought-after printer in 1988, with its fast 24-pin printhead, wide carriage and color graphics printing capabilities.

In the dot-matrix world, you could purchase print cartridges for fonts not included in internal memory (graphical printing was interminably slow and used only for charts). Cartridges for Courier, Orator, Prestige Elite, Tiempo and other fonts could be had for \$55 apiece.

The front panel of the Alps had controls for setting line spacing, dot pitch, font and print mode (draft, medium or high quality). Color printing could produce seven shades with a four-color ribbon and overstriking, and each software program that you used with it had to have its own print driver. Fortunately, the Alps was Epson-compatible, so most popular programs supported it.

Perhaps most astonishing is the Alps' price tag: \$995 before add-ons such as sheet feeders, cartridges and a serial port. Today, you can get a high-resolution inkjet printer (like the [Canon Pixma iP3500](#)) that produces great graphics and photos for \$80 or so. Though ink and paper are still expensive, they're competitive with what online printing services charge. And you can print anything on your PC at the click of a button -- no changing cartridges and setting print parameters for every job.

The Pixma even has two print trays, so you can keep a second paper type on hand. And perhaps most convenient of all, we can share printers over a Wi-Fi network with Windows Print Sharing and print directly from digital cameras with PictBridge USB technology.

The printer of the future likely won't be judged on its pixels and droplets, but on how well it fabricates everyday things. The first 3D printers are already in use for design prototyping, and "fabbers" will eventually be able to make entire working circuit boards or customized objects while you wait.

Internet Access



1988: CompuServe

- **Price:** \$6.00 to \$47.50 per hour (\$11 to \$83 adjusted for inflation)
- **Connection:** dial-up
- **Speed:** 300 to 9,600 baud
- **Services:** 400 databases, covering news, shopping, finance and the like; 140 discussion groups, e-mail



2008: AT&T Elite DSL

- **Price:** \$35 per month
- **Connection:** Digital Subscriber Line
- **Speed:** 6 mbps
- **Services:** nearly anything you can imagine

Think back to a time when you had to use AOL to get online, and were mostly limited to the channels and information that service provided. Now delve even deeper into the misty past, to an age when there was no Web at all, much less a graphical interface.

The world of [CompuServe](#), the leading online service of the 1980s, consisted of menus and pages in a command-line interface. You'd work your way down a series of menus to get to your car-restoration SIG (special interest group), back up and head over to check stock prices and move out through a special gateway to make a plane reservation on Eeasy Sabre. All of that text menu navigating was costly: \$12.50 per hour at 1,200 or 2,400 baud, and up to \$47.50 for 9,600-baud access. Just getting there could be expensive, too. Unless you had a Tymnet or Telenet network gateway in your local dialing area, you had to budget for per-minute phone charges on top of everything else. A \$500 CompuServe bill and a \$200 access fee were by no means uncommon.

AOL launched in 1989, signaling the death of videotex services, and the Web arrived in 1993. In comparison to 1988's, today's high-speed broadband service seems practically free.

Cable modems took the early lead, but this year DSL households are expected to overtake cable households for the first time ever, largely due to deep discounting by AT&T and other carriers. AT&T's basic service starts at just \$20 per month, and the 6-mbps Elite service is priced at \$35, with no contract required. AT&T even throws in free Wi-Fi service at McDonald's and Starbucks locations.

The future is personal broadband access that goes with us everywhere: Home and cellular broadband access will become one service.

Modems



1988: Hayes V-Series SmartModem 2400

- **Price:** \$399 (\$699 adjusted for inflation)

- **Speed:** 2,400 baud
- **Interface:** serial
- **Standard supported:** v.22bis



2008: Motorola SurfBoard S5101 Cable Modem

- **Price:** \$60
- **Speed:** 38 mbps down/30 mbps up
- **Interface:** Ethernet and USB
- **Standards supported:** DOCSIS 1.1 and 2.0

In 1988, one of the first questions you'd ask a new computing friend was, "How fast is your modem?"

If the person said 300 baud, you'd nod sympathetically; 1,200 or 2,400 baud got them a friendly smile; and 4,800 or 9,600 turned you green with envy.

By 1988, the price of the industry-standard 2,400-baud Hayes V-Series SmartModem had plummeted from its original \$1,000 to \$400, and clones could be found for \$100 -- a pittance compared to the \$6 to \$12 per hour you had to pay for online fees.

You'd also have to invest \$50 in terminal software like Smartcom, which sent dialing commands to the modem.

Today, few broadband users even know the brand of their modem, much less its model number or speed. You might be able to say whether you have 6- or 12-mbps service, but the modem itself has been reduced to a fungible commodity, often provided for free by your ISP.

The Motorola SurfBoard is a common carrier-supplied cable modem that supports up to 38 mbps, though most users won't achieve that speed due to various limitations in the service they pay for.

The next frontier for modems and connection speeds will likely involve a new pipe to your house, such as fiber-optic or high-speed wireless service. Verizon is building FIOS as fast as it can, and consumers are snapping it up. Wireless will be the answer in rural areas where stringing new cable is too expensive.

Cell Phones



1988: Motorola DynaTAC 8500XL

- **Price:** \$2,500 (\$4,382 adjusted for inflation)
- **Technology:** analog
- **Weight:** 28 ounces
- **Talk time:** one hour



2008: Apple iPhone

- **Price:** \$399 (with two-year service agreement)
- **Technology:** EDGE/GSM quad-band
- **Weight:** 5 ounces
- **Talk time:** eight hours

The [Motorola DynaTAC 8000X](#), introduced in 1984, was the world's first truly portable cell phone (as opposed to a car phone) that didn't require a mobile operator to connect a call. It was a 10-inch tall brick -- not something you'd carry in your pocket -- and it sold for \$3,995. Nonetheless, its popularity took off among real estate agents, stockbrokers -- [and drug dealers](#).

By 1988, about 800,000 cell phones were in use in the United States, and roaming agreements had been set up that allowed service subscribers to use their phones outside their local area. McCaw Cellular Communications (which later merged with AT&T to become AT&T Wireless) was the biggest carrier.

Phone prices had drifted downward but were still very high, averaging \$2,300 for portable models. A typical monthly bill was \$100 to \$150, with charges of 50 cents per minute for both incoming and outgoing calls.

Phones and service remained very basic, with no voice mail, call forwarding, caller ID or other niceties that we now take for granted; and Wi-Fi, Bluetooth, camera capabilities, touch-screens, music and video playback and Web access (all provided by the iPhone) were beyond the horizon altogether. The 8500XL did have an LED display and enough memory to retain 30

numbers. A few years later, however, Motorola introduced the StarTAC -- the first clamshell flip phone -- and the true pocketable phone was born.

What's next? [Google's Android initiative](#), with working prototypes shown this month at Barcelona's Mobile Congress, promises an open smart-phone platform, which may end the era of carriers' stranglehold on handsets.

Big-Screen TVs



1988: Mitsubishi Diamond Vision II 3503

- **Price:** \$3,000 (\$5,258 adjusted for inflation)
- **Size:** 35 inches
- **Resolution:** 480 lines, interlaced
- **Format:** NTSC
- **Display technology:** CRT



2008: Panasonic TH-50PZ77U HDTV

- **Price:** \$2,300
- **Size:** 50 inches
- **Resolution:** 1080 lines, progressive scan
- **Format:** ATSC
- **Display technology:** plasma

When Mitsubishi shipped its [35-inch Diamond Vision television in 1985](#), it was the world's biggest cathode-ray-tube TV. By 1988, popular electronics columnist Harry Somerfield said that the company's model 3503 offered "probably the best big picture available anywhere, at any price."

The phrase "at any price" was apt, since (in 2008 dollars) the 3503 cost \$5,258. The smooth image quality and excellent color of analog CRTs still beats what plasma and LCD sets can produce, but tubes have some practical limitations: A 35-inch CRT weighs about 200 pounds, and it's about 2 feet deep. The demand for ever-larger screens has prompted a switch to flat-panel TVs. One of today's top models is the [50-inch Panasonic TH-50PZ77U](#), a plasma-screen television that has garnered a slew of awards.

Sharp predicts that by 2015 [the average TV screen size will have increased to 60 inches](#). Organic light-emitting diodes, the next big thing in display technology, will offer breathtaking image quality. The 60-inch screens of the future may be OLED-based, but the technology still has some maturing to do: The OLED screen on Sony's new \$2,300 XEL-1 measures just 11 inches.

Video Players



1988: Pioneer CLD-1010 Laserdisc Player

- **Price:** \$1,427 (\$2,278 adjusted for inflation)
- **Resolution:** 420-line
- **Output:** composite
- **Media supported:** Laserdisc, CD-audio, CD-video



2008: Panasonic DMP-BD30K Blu-ray Disc Player

- **Price:** \$500
- **Resolution:** 1080-line
- **Output:** HDMI
- **Media supported:** Blu-ray 1.1, DVD (with upscaling), CD

Laserdisc was the Blu-ray of 1988 -- a high-quality alternative to the then-dominant video media (VHS tape then; regular DVD now). And like Blu-ray gear today, Laserdisc players commanded a premium price.

The Pioneer CLD-1010 doubled as a CD-audio player; and later models could play DVDs, too. But Laserdisc never gained widespread support from equipment makers and movie studios, and as a result its household penetration in the United States peaked at just 2 percent.

The last movie on Laserdisc came out in 2000. The format survived that long thanks to a cult following among enthusiasts who preferred its smooth, [filmlike analog quality to the sometimes blocky and banded DVD format](#). In fact, astonishingly enough, [Pioneer still makes combination Laserdisc/DVD players](#) for hardcore fans of the Laserdisc format.

With Blu-ray's high-definition video, however, the argument is over. Significantly, Blu-ray already enjoys more industry support than Laserdisc ever did. And with buyers flocking to big HDTVs, which are hungry for 1080p content, Blu-ray seems assured of a secure future -- [at least until Super Hi-Vision comes along](#).

Portable Audio Players



1988: Sony Discman D-10

- **Price:** \$350 (\$613 adjusted for inflation)
- **Format:** CD-audio
- **Capacity:** 650MB or 70 minutes
- **Batterylife:** 4 hours
- **Weight:** 14 ounces



2008: Apple iPod Touch

- **Price:** \$299
- **Formats:** AAC/MP3/AIFF/WAV/ lossless audio
- **Capacity:** 8GB or 87 hours
- **Batterylife:** 22 hours of audio or 5 hours video
- **Weight:** 4.2 ounces

The New York Times' Hans Fantel of [rhapsodized about the wondrous Sony D-10 in 1987](#): "This complex piece of laserized machinery easily fits into the pocket of my raincoat. And when it isn't raining, I just sling it over a shoulder with a strap ... the new elastic mounting of the laser makes it less likely to skip when bounced or jostled in portable use."

Though [the iPod Touch](#) offers skipless playback, thanks to its solid-state memory, portable audio quality has actually [declined from what it was in the Discman](#) years, because formats like MP3 and AAC compress files at the expense of sonic detail.

But the Touch's many other features -- including video playback, touch-screen operation, and wireless e-mail and Web browsing -- tip the value equation in its favor.

In the future we'll probably get our portable audio via subscription and live Web streaming. Who needs to carry around a library when you can access any song you want from the Internet cloud?

Cameras



1988: Canon EOS 650

- **Price:** \$600 (\$1,052 adjusted for inflation)
- **Format:** analog 35mm film
- **Capacity:** 36 shots
- **Preview:** optical viewfinder
- **Speed:** 1/2000 shutter and 3-fps auto advance



2008: Canon EOS Digital Rebel XT

- **Price:** \$600
- **Format:** 10MP digital JPEG
- **Capacity:** determined by CF Card
- **Preview:** 2.5-inch LCD and optical viewfinder
- **Speed:** 1/4000 shutter and 3-fps for up to eight shots

The price and the looks of Canon's entry-level autofocus SLRs haven't changed much in 20 years -- but with the switch from film to digital images, the technology certainly has.

The [EOS 650 was the first in Canon's EOS line](#), and it introduced the first fully electronic lenses. Amazingly, those EF (Electro-Focus) lenses are still usable on today's digital EOS models.

The 650 had spot-matrix metering -- a big advance at the time -- and a convenient mode dial that [lives on in the EOS Digital Rebel XTi](#).

But of course film is utterly different from digital images, and it took a long while for the resolution and speed of digital SLRs to roughly equal those of 35mm film. [Now that parity has been achieved](#), the convenience of digital has [knocked the bottom out of the film market](#).

The latest advance that should make its way down to consumer digital SLRs involves [full-frame image sensors](#). These sensors are the same size as 35mm film, allowing photographers armed with DSLRs to use lenses designed for analog SLRs to full advantage.

Game Consoles



1988: Nintendo NES

- **Price:** \$200 (\$351 adjusted for inflation)
- **CPU:** 1.79-MHz 8-bit
- **RAM:** 2KB
- **Game format:** cartridge



2008: Sony PlayStation 3 40GB

- **Price:** \$399
- **CPU:** 3.2-GHz cell
- **RAM:** 256MB
- **Game format:** optical- and hard-disk-based games with Internet connectivity

The [Nintendo NES](#) was a great value and the runaway-hit game console of its time, selling 60 million units worldwide. NES's flagship game title, Super Mario Brothers, holds the all-time video game sales record, and it lives on in the [Nintendo Wii](#). Even in 2008 dollars, the NES costs less than the Sony PlayStation 3, though the PS3 doubles as a Blu-ray movie player.

There's no comparison in image quality, however. The NES was limited to 64 8-by-8 or 8-by-16 animated "sprites" on screen at one time, and just 48 colors with five gray levels; the PS3 provides realistic full-color, full-motion animation with [its advanced Cell](#) and video processors.

That said, people probably had just as much fun playing [The Legend of Zelda](#) back in 1988 as they do now playing [Call of Duty 4: Modern Warfare](#).

Undoubtedly another generation of consoles will follow this one, and it will offer even more-realistic imagery and more-precise control devices. Nevertheless, the biggest trends in gaming today are the growth of family content and the evolution of virtual worlds, as evidenced by the Wii and by Second Life.