

## **The next 25 years in tech**

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### **PCs may disappear from your desk by 2033. But with digital technology showing up everywhere else -- including inside your body -- computing will only get more personal.**

The future ain't what it used to be. In the pre-PC era, futurists predicted huge changes in transportation. By 2008 we would be flitting about in personal jetpacks and taking vacations on the moon. But the communications revolution spurred by personal computers and the Internet wasn't on anyone's radar. (Read more in "[Canadian Innovation Coming Soon.](#)")

Now the technology landscape is on the verge of changes that will transport us to places few people have imagined. We know that computers will be vastly more powerful, mobile, and connected. The question for the next 25 years is whether we'll be able to tell where technology ends and the rest of our life begins. (Don't miss the slideshow "[5 Sci-Fi Scenarios that will come true](#)")

Technology will become firmly embedded in advanced devices that deliver information and entertainment to our homes and our hip pockets, in sensors that monitor our environment from within the walls and floors of our homes, and in chips that deliver medicine and augment reality inside our bodies.

This shiny happy future world will come at a cost, though: Think security and privacy concerns. So let's hope that our jetpacks come with seat belts, because it's going to be a wild ride.

### **The Incredible Disappearing PC**

Whether you have a PC on your desk in 10 to 15 years will be a matter of choice, not necessity. If you do, it will be vastly more powerful than your current system, thanks to advances in nanotechnology, says Doug Tougaw, an engineering professor at Valparaiso University who is developing nanocomputers.

"We're getting closer to our goal of creating computers that are a thousand times faster and smaller and use one-thousandth of the energy of today's computers," Tougaw reports. "As processors get smaller, they'll be embedded into more things. We'll also use standard-size machines packed with hundreds of chips. So we'll have very intelligent consumer products and unbelievably powerful PCs."

Computers using nanotechnology will debut in about five years, he says. Five to ten years after that, silicon will reach a point at which quantum mechanics won't allow chip pathways to get any smaller, so electric-current-based PCs will give way to optical computers that transmit streams of light instead of electrons, or perhaps to quantum computers that rely on the strange physics of atomic particles to deliver processing brawn.

"Starting around the year 2018, we'll have optical computers that operate at the speed of light, sending thousands of message streams down a single channel," says William Halal, professor emeritus at George Washington University and author of *Technology's Promise: Expert Knowledge on the Coming Transformation of Society*, to be published in April.

Most of tomorrow's CPU muscle will go toward making the user interface seamless and ubiquitous. Keyboards and mice may persist, but they'll become secondary to voice and gesture.

Gesture-based interfaces are catching on fast. The Nintendo Wii's gesture-based controllers are one example. And the iPhone's touch screen responds differently to finger taps than to swipes; Apple rolled similar technology into its MacBook Air's touchpad in January. GestureTek uses the input from camera phones to deliver gesture control.

Once freed from the keyboard, you'll be able to talk or gesture to your computer from virtually any display in your home. Or you may carry your pocket-size computer with you and beam the image to a nanocomputer embedded in the nearest wall-size screen. Paper-thin displays are inching closer to reality, too. Late last year, Sony released its \$2500, 11-inch XEL-1 organic light-emitting diode (OLED) HDTVs; and at January's Consumer Electronics Show, the company presented a prototype 27-inch OLED HDTV.

Meanwhile, what you see on screen will look a lot more like real life than in present-day 3D virtual worlds, predicts Halal. "When you want to buy a book, instead of going to Amazon's home page, you'll be greeted by a virtual salesperson," Halal says. "The avatar will find the book you're looking for and conduct the transaction, just as you would with a real person."

Michael Liebhold, senior researcher at Palo Alto, California's Institute for the Future, says your PC may project a holograph, so you can manipulate files and objects with your hands.

Of course, you may not have a traditional computer at all. For many people, the PC of the future will be a dumb terminal, with storage, software, and processing power distributed across an Internet cloud. Amazon, Dell, and IBM have introduced cloud services for businesses; and Google and Zoho now serve up Web applications to consumers.

In years to come you'll enjoy ubiquitous Internet access, perhaps using part of today's TV spectrum. Such access will deliver your "desktop" from a portable device or Internet terminal. Instead of a user name and password, you'll provide a fingerprint, voice, or retinal scan. "Your identity becomes your access point to your files and applications," says Patrick Tucker of the World Future Society, in Bethesda, Maryland. "Your digital life will follow you around like a shadow."

### **Surrounded by Intelligence**

We're entering the era of "ambient intelligence," when everyday objects will contain technology that broadcasts data about themselves and their environment, says Liebhold.

As you approach a dangerous intersection, sensors in your car will detect it and reduce speed. GPS coordinates of places unsafe to walk at night will be broadcast to mobile devices.

In Japan, location-based services from GeoVector let the Mapions Pointing Application deliver information on businesses inside a building at the point of a GPS-enabled camera phone. U.S. handsets with the technology should appear by year's end.

In homes, floor sensors will detect empty rooms and automatically lower the thermostat and turn off lights. Agilewaves, a firm started by ex-NASA scientists, is working with builders to install sensors on electrical switches, pipes, and gas valves. Eventually they hope to offer neighborhoods, subdivisions, or municipalities a big-picture view of their carbon footprint.

Future homes will have "a dashboard that gives real-time performance feedback," says Peter Sharer, CEO of Agilewaves. "Homes that have this instrumentation are more likely to hook into

their neighbors' homes. In 10 or 15 years, entire communities will be networked."

The most significant use of sensors in homes, however, will be to monitor inhabitants' health. An FDA-approved under-the-mattress monitor activates when heart patients lie down. Japan's Matsushita has built a toilet seat that sends tiny electric charges through a users' buttocks to measure body fat.

### **Our Computers, Ourselves**

Ambient computing will extend from house walls to body cells. Verichip makes a pea-size radio-frequency identification (RFID) chip that can be injected under diabetes patients' skin to monitor glucose without a blood sample.

Researchers at the University of Edinburgh in Scotland are exploring how to spray computerized sensors into patients' chests during heart surgery, so the sensors can relay information to the hospital computer. The process could be commercially viable within ten years.

Body computers will progress from monitoring health to delivering medical care and ultimately to augmenting reality by piping the Internet directly into the brain--if people can overcome their squeamishness about brain implants. "There's a very short leap between implanting a [cochlear] device and one that lets you receive data directly from the Net," Tucker says.

Researchers are moving ahead boldly. For three months in 2002, Kevin Warwick, a cybernetics professor at the University of Reading in England, lived with electrodes implanted in his arm. In one test, he wired them to an Internet-connected PC and then temporarily attached electrodes to his wife's arm as well. Warwick described this experiment in a 2006 interview with ITWales.com: "[W]hen she moved her hand three times, I felt in my brain three pulses, and my brain recognized that my wife was communicating with me. It was the world's first purely electronic communication from brain to brain, and therefore the basis for thought communication."

### **Bumps in the Road**

But before we wire our bodies, we need a far more secure network than today's Internet and better privacy safeguards for the petabytes of consumer data that an always-connected world will generate, says Pradeep Khosla, codirector of CyLab, Carnegie-Mellon University's computer security think tank.

Ari Juels, chief scientist for data security company RSA, says that biometrics and encryption will help with access security; but trouble may still arise when data reaches users' screens. Context-smart back-end systems will help. "They'll know that, if you are in San Francisco right now, someone in Thailand shouldn't be using your credit card number," Juels explains.

Khosla says that a combination of technology, education, and tough legislation against "the abuse and misuse of information" is the best way to surmount the privacy hurdles that remain. "I don't think we're quite there yet," he adds.

In Liebholt's view, the issue of privacy needs to be elevated. "I don't think it's a foregone conclusion that our privacy will be lost or that it will be protected. It's our fate. We have control over the future; we're not victims of it."

## Remains of the Day: Life, Bit by Bit

We have met Big Brother, and he is us. Tiny cameras and wireless connections may herald an era of "sous-veillance"--observation from below--says Jamais Cascio of the Center for Responsible Nanotechnology. Cameras and microphones in your glasses or shirt buttons will record every moment, upload it, and let you replay the good bits.

Steve Mann, a professor at the University of Toronto, has used wearable computers to record nearly all of his waking life since 1981 (see the video "[nVidia GPU Computer Vision for Mediated Reality](#)"). Microsoft researcher Gordon Bell has collected his life's work in his MyLifeBits project.

"Imagine recording every conversation you've ever had with your spouse," Cascio says. "That kind of enhanced, easily searchable memory will change what it means to be a person in a way that most technology doesn't."

## A Factory on Your Desk



Photograph: Courtesy of FAB@HOME

One day you might order a new coffee pot, or even a new laptop, and not have to wait for delivery. Instead, you'll use a printer-size factory to download and build it.

Already, 3D inkjet printers build prototypes for industry. Chemical giant BASF is developing inks that will enable ordinary printers to spit out paper or plastic circuit boards. For \$2400, you can buy a [Fab@home](#) desktop fabricator that lets you build objects out of acrylic; the company hopes to produce units that can build with multiple materials in the future.

The Center for Responsible Nanotechnology predicts that personal nanofactories will be in operation by 2020. Jamais Cascio, founder of Open the Future and a director at CRN, says nanofactories will have a huge impact: "If it becomes cheaper and more efficient to have something printed out locally instead of made in China, it will have a big effect on things like trade balances, international labor, and...our national economy."