PART VII

Governance and Globalization

Ultimately, the future of technology and society will be shaped to a significant extent by the actions of government. Looking back on the technologies discussed in the first six parts of this book, it is clear that the shape of virtually all of them has been influenced by government funding, government regulation, or some other type of government activity or policy. Likewise, these technologies have contributed to the shape of society in the past, are helping to shape it today, and will do so in the future. One of the most significant ways in which technology is shaping society is through globalization. The next-to-last chapter in this section of *Technology and the Future* addresses the government dimension of the technology-society relationship, while the final chapter provides a vivid close-up picture of one aspect of globalization.

Chapter 27 is a short piece that I wrote originally for an encyclopedia of science, technology, and society. In it, I discuss several aspects of the relationship between government and technology, including government support for the development of technology through direct investment in research and development; indirect investment such as subsidies within the tax system; and other means, such as creating an innovation-friendly economic and political environment, and forcing technological change by setting regulatory standards that cannot be met with existing technologies. Although my frame of reference is mainly the United States, the chapter also devotes some attention to institutions and situations in other countries.

The final chapter is an excerpt from Thomas L. Friedman's best-selling book, *The World is Flat.* Friedman describes, in his typically readable terms, a visit to a call center in Bangalore, India, in which hundreds of young Indians, trained to imitate American accents, staff telephone lines on which they do everything from promoting credit cards to helping callers solve computer problems. The point of this ntertaining vignette is to illustrate the globalization of innovation and its impacts in the world economy. As Friedman points out, even as jobs such as those in the all center have been outsourced to India and other emerging economies, the ncome generated by those jobs has helped to increase demand for American goods and services in those countries.

27

Government and Technology

ALBERT H. TEICH

Governments worldwide are deeply involved with technology. In this chapter, which I prepared originally for an encyclopedia of science, technology, and society, I discuss briefly the role of governments as promoters, regulators, and users of technology. "Briefly" is a key word here because the encyclopedia, a nearly 700-page opus edited by Sal Restivo of Rensselaer Polytechnic Institute, includes nearly 150 entries covering an enormous range of topics from abortion to robots to the Tuskegee Project (an infamous study in which a U.S. government agency deceived a group of African-American men with syphilis into serving as an untreated control group for many years in order to test the effectiveness of penicillin). The breadth of the book's coverage placed severe limits on the length of individual entries.

Despite its brevity, this chapter, like the rest of Technology and the Future, *treats technology broadly, discussing topics ranging from regulation of pharmaceuticals to use of technical information by legislative bodies, to the role of the military in technology development. Also, like the book as a whole, the chapter raises more questions than it answers and will serve, I hope, to provoke deeper reflection and further study of the topics with which it deals.*

When this chapter appeared in the eleventh edition of Technology and the Future, *it was the first time since the book was originally published in 1972 that I had included a chapter of my own. I am currently (as of mid-2011), Senior Policy Advisor at the American Association for the Advancement of Science in Washington, DC, where I was for the previous 20 years Director of Science and Policy Programs. Additional information about my background can be found in the "About the Editor" page at the beginning of the book and online at* http://www.alteich.com/al.

From Albert Teich, "Government and Technology," in *Science, Technology, and Society: An Encyclopedia*, pp. 170–175.

G overnments have been involved with technology throughout human history, at least since the days of the Pharaohs in ancient Egypt. Military tech- ›logy was essential to the power of medieval governments, and modern ›vernments employ technology to stimulate economic growth, improve their :izens' standards of living, and pursue missions in many other areas, including .vironment, public health, and defense. The involvement of governments with :hnology can be described under three broad headings: promotion or develop- ent of technology; regulation of technology; and use of technology and tech- cal information in government policy making.

GOVERNMENT'S ROLE IN TECHNOLOGY DEVELOPMENT

overnments support the development of technology both directly and indi- ctly. Direct funding of research and development (R&D) provides government ith a means of shaping technologies according to public policies. In fiscal year)10 the U.S. federal government spent an estimated $148.5 billion, or about ur percent of the overall federal budget, on R&D. [These figures have been ›dated from the original.— Ed.]

Some government-funded R&D provides the foundation for development of oducts intended to be manufactured and sold by industry, such as electric cars or ıproved airport screening devices. Other government investments help build the .tion's long-range scientific and technological strength; examples are the ational Nanotechnology Initiative in the United States and the Sixth Frame- ork Programme of the European Union. Direct funding of R&D is a major nction of government in virtually all industrialized countries and has grown arply in the past half-century, in concert with the increasingly technological ıture of society and the growing role of technology in the world economy.

In the United States, direct federal government support for development of ımmercial technologies is politically controversial. The history of federal efforts promote industrial technology goes back at least to the 1920s, but virtually all ch initiatives have become enmeshed in disputes between political leaders who lvocate an activist role for government in the nation's economy and those who e government's role as more limited and subordinate to the market. During the ıst decade, one focus of controversy has been the Advanced Technology Pro- am [now the Technology Innovation Program] of the Department of Com- erce, a relatively small program that provides subsidies for firms to do R&D ı technologies whose chances of succeeding are too small to attract private vestors but whose potential payoffs are great. Republican presidents and con- essional leaders have sought to kill the program at every opportunity, while emocrats have stood fast in its defense. Programs of this nature are more readily cepted in many other nations, whose governments are less concerned with .ues of what is or is not appropriate for government. In France, for example, NVAR (Agence Nationale de Valorisation de la Recherche, called the French

Agency for Innovation in English), promotes and finances innovation in French industry, particularly in small and medium-sized enterprises and facilitates the emergence of new products and processes.

Many state governments in the United States, eager to attract or retain high-paying jobs in technology-based industries, also subsidize commercial technological development. Michigan is using funds acquired from the settlement of a huge multistate lawsuit against the tobacco industry to leverage investment in biotechnology businesses in order to build a "life sciences corridor" in the southern part of the state. Pennsylvania's Ben Franklin Partnership has invested more than $300 million of state funds in technology development since its founding in 1982.

A large share of government investment in R&D in most countries is primarily intended to serve government's own needs, for example, strengthening military capabilities, building better roads and bridges, or providing a scientific basis for regulating food and drug safety or the environment. This kind of R&D can also help to strengthen technology-based industry. In some cases, the resulting technologies may be adapted for commercial uses or may be "dual-use," directly serving commercial as well as government users. In the United States, the Department of Defense (DOD) is an important source of such funding. Slightly more than half of all federal funding for R&D in the United States typically comes from the defense portion of the federal budget in any given year. Among the civilian technologies that originated or were supported in early stages by DOD R&D funds are the Internet, microelectronics and integrated circuits, optical fibers, and many aeronautical and space technologies. Other U.S. agencies that support technology development for government use are the National Aeronautics and Space Administration (NASA), the Department of Energy, and the Department of Homeland Security.

Governments also provide indirect support for technology development. Some of this support takes the form of subsidies to the private sector through tax codes. Most industrial nations encourage industrial firms to invest in R&D by allowing 100 percent of R&D expenses to be deducted from a firm's income tax. Australia, where industrial investment in R&D has long been regarded as insufficient for the nation's long-term economic growth, allows a 125 percent deduction. Some nations, including the United States, Canada, Japan and France, also allow firms that increase their R&D spending to take a certain percentage of the increase (20 percent in the case of the United States) as a tax credit. With this mechanism, governments can increase industrial investment in R&D while allowing individual firms to choose technologies and R&D projects according to their own needs and judgment.

Other indirect mechanisms that governments use to support technology development include regulation and creation of a suitable environment for technological innovation — for example, by providing protection for intellectual property. To force the development of technology, government may establish a future regulatory standard that it knows cannot be met with existing technology. Such a standard puts pressure on firms in the affected industry to conduct R&D and develop technology that can meet the standard. The best-known American example of technology forcing is the Clean Air Act Amendments of 1970, which required automakers to

:e the exhaust emissions of new vehicles by 90 percent in four to five years. legislation, and the mandate three years later for eliminating leaded gasoline, o the implementation of the catalytic converter — although this was not nplished within the time frame specified in the law.

If they hope to profit from their innovations, firms and organizations that luct R&D, as well as individual inventors, need to establish property rights nem. Governments provide the means for protecting such rights through nts and copyrights in order to create an environment that will encourage nological innovation. The U.S. Constitution provides the basis for patent ection, and the legal system allows innovators to defend their patents when ers threaten to infringe on them. In recent years, developments in informa- technology as well as in the life sciences have posed new challenges to tra- onal concepts of intellectual property, raising issues such as whether life forms DNA sequences can be patented, what kinds of rights apply to computer le, and whether it is possible or desirable to protect the rights of intellectual perty owners in a world where those properties (such as music, movies, and oks) can be readily duplicated by almost anyone with a computer and shared rldwide on the Internet.

Another important way in which governments are involved with technology velopment is through the establishment of standards. From keeping exact time ensuring that one person's or company's inch, centimeter, or kilogram is exactly e same as another's, or that a bolt with a certain thread specification fits into a it with that thread, or that a nation's television receivers are compatible with its oadcasters, standards are fundamental to technology, commerce, and trade. In e United States, the National Institute of Standards and Technology (NIST) is sponsible for these functions. NIST laboratories develop new physical standards id measurement methods. It also provides basic reference standards and works ith industry to calibrate measuring instruments to those standards and with inter- ational organizations to ensure compatibility with other nations' standards.

REGULATION OF TECHNOLOGY

As they develop and as they affect society, technologies raise issues that create demands for government regulation. These issues may involve human health and safety or the environment; allocation of technological resources, such as the electromagnetic spectrum; protection of consumers from fraudulent or defective products; social goals, such as bringing the benefits of technology to diverse popu- lations or geographic regions; or political goals, such as preventing the acquisition of technologies by foreign enemies, economic rivals, or terrorists. At times, the issues may also involve ethics, as in the case of research involving human embryos and reproductive cloning.

Virtually all countries have government agencies that regulate technology. In the United States, several federal agencies are responsible for regulation to pro- tect human health and safety, including the Food and Drug Administration, the

Occupational Safety and Health Administration, the Environmental Protection Agency, and the Nuclear Regulatory Commission. In Canada, the Health Products and Food Branch of Health Canada performs functions similar to the U.S. Food and Drug Administration. In Germany, the analogous agency is the Federal Institute for Drugs and Medical Devices.

Among the products that the U.S. Food and Drug Administration (FDA) regulates are vaccines and other biologics, such as blood and blood products; cosmetics; medical devices, such as pacemakers and contact lenses; foods, with regard to processing and contamination; and prescription, as well as over-the-counter, drugs. Before a prescription drug can be marketed in the United States, it must go through an elaborate approval process. Based on animal studies and human clinical trials, the FDA must determine (1) whether the drug is safe and effective in its proposed use(s), and whether its benefits outweigh its risks; (2) whether the drug's proposed labeling is appropriate, and what it should contain; and (3) whether the methods used in manufacturing and quality control are satisfactory. The process often takes years and costs millions of dollars. The considerations are similar in most other countries, although the judgments of risks and benefits may differ among them. Because the regulatory process often creates long delays between the discovery or invention of a new drug and its availability to patients, and because of the high costs involved, drug regulation is often the subject of controversy. Controversies also arise in regulation of the environmental effects of technologies or in regard to safety issues. The U.S. Environmental Protection Agency and its counterparts in other nations, such as Environment Canada and the Swedish Environmental Protection Agency (Naturvårdsverket), are charged with the enforcement of laws intended to prevent or remediate environmental pollution. Preventing pollution of rivers, lakes, and other bodies of water imposes costs on firms whose production processes create potential pollutants. The same is true of sources of air pollution, such as that produced by coal-burning power plants, oil refineries, and automobiles. Those who are asked to pay these costs quite naturally resist, generally arguing that the presumed benefits do not justify the costs. The disputes often focus on uncertainties in the data on which the regulations are based.

Probably the most significant controversy of this nature in the United States in the early twenty-first century relates to the problem of global climate change. A strong consensus has developed among scientists that the earth's surface temperature is rising; that it is rising at an accelerating rate; that the rise is being caused by human activities, especially the increase of atmospheric carbon dioxide due to the burning of fossil fuels; and that the increase is likely to cause serious problems in the next 50 to 100 years, including greater climate instability and a significant rise in sea level. Most of the nations in the world have agreed to take action to slow or halt the rise. This action will be very costly, but failure to act could be even more costly. The United States, which has the world's largest economy and is the [second] largest emitter of carbon dioxide and other greenhouse gases [China became number one in 2007 – Ed.], would bear the largest share of the costs. The federal government and much of the U.S. business community have resisted taking action, arguing that there are too many uncertainties — regarding how ıch the climate is changing, what the potential impacts are, and what may be ısing the changes. The dilemma is a central one in the regulation of technology: ɔw certain must one be in order to take a regulatory action, especially when that tion is likely to be costly?

The controversy over genetically modified organisms (GMOs), especially in ɔds, is similar. Guided by the "precautionary principle," which holds that vhen an activity threatens harm to human health or the environment, precau- ›nary measures should be taken even if some cause-and-effect relationships are ›t fully established scientifically," most European nations assert that GMOs ould not be allowed in foods. United States regulators, arguing that there is › persuasive scientific evidence that GMOs are harmful, and citing many ben- .ts, have generally rejected the European position.

USE OF TECHNICAL INFORMATION IN GOVERNMENT DECISION MAKING

; the global change and GMO issues illustrate, technology is an increasingly ıportant factor in the programs that governments undertake, in the problems at confront them, and in the policies that they develop in response to, or in ıticipation of, these problems. These policies require specialized knowledge that ›vernments must either maintain internally or obtain from outside sources. The ›vernment agencies that use technology or fund R&D have engineers and ientists on their staffs. Some, like NASA, have a substantial number; others ıve relatively few. Virtually all of these agencies, however, have technical advi- ry committees that supplement their in-house capabilities.

At the top levels, governments of most industrialized countries have bodies at provide science and technology advice to their leaders. Since World War II, e president of the United States has had a science and technology advisor, sit- ıted throughout most of the period in the Executive Office of the President. In e administration of President George W. Bush, the advisor became a special sistant to the president, serving as director of the White House Office of Sci- ıce and Technology Policy and also as co-chair of an external advisory group ıown as the President's Council of Advisors on Science and Technology. The fluence of the advisor and the advisory councils and committees has waxed and aned depending on the nature of the issues facing the president, the power ructure within the White House, and the president's personality and degree of terest in scientific and technological matters.

Departments and ministries often have their own science and technology lvisory committees as well. In the United States, the Department of Energy, ıe Environmental Protection Agency, the Department of Defense, and many :her agencies have such committees. United States government agencies also ɔtain technical advice from the National Research Council (NRC), which is ıe operating arm of the National Academies of Science and Engineering and of ıe Institute of Medicine. With a staff of over 1,000, the NRC conducts hundreds of studies each year to provide government agencies with authoritative advice on topics ranging from super-computing to smallpox. Agencies also obtain information and advice through studies conducted by universities, nonprofit institutions (such as the RAND Corporation), and private firms under contracts and grants.

Although executive branch agencies and their counterparts have many resources for science and technology information and advice, the situation is different for legislative bodies. Members of parliament in most nations have very limited personal and committee staffs. With relatively few positions available, staff members must be generalists: those with technical expertise are rare, except on specialized committees. Supplementing these staffs are such bodies as the Library of the House of Commons in the United Kingdom. The Library produces research papers, a small fraction of which are devoted to science and technology. The United Kingdom, however, also has a small Parliamentary Office of Science and Technology (POST), which provides more specialized advice on technical topics. Since its establishment in 1989, POST has produced reports for Parliament on subjects ranging from broadband Internet access to stem cell research.

Things are different in the U.S. Congress. It is not uncommon for senators to have personal staffs ranging from 50 to 100. Representatives' staffs are smaller, but they are still considerably larger than their parliamentary counterparts in other nations. Senators and representatives who have committee assignments relating to technology or science, or who have major research facilities in their constituencies, can therefore afford to hire some staff with technical qualifications. In addition, science and engineering associations have since 1973 maintained fellowship programs that make Ph.D.-level scientists and engineers, selected through national competitions, available to members of Congress for one-year assignments. Other nations are beginning to initiate such programs as well. Switzerland has established one on a small scale, and the United Kingdom, Australia, Japan, and South Africa are all considering doing so.

The Office of Technology Assessment (OTA), created by the U.S. Congress in 1972, was the first governmental body devoted exclusively to conducting studies and providing advice to a legislature on the impacts of technology on society. The agency conducted hundreds of studies for Congress on subjects ranging from advanced networking technology to AIDS to the lumber industry. It was unique among agencies serving the U.S. Congress not just in the range of its work, but also in the depth of its technical expertise and in the long-term view it brought to its studies.

In 1995, in what was officially called an economy move, the U.S. Congress eliminated funding for OTA. Other nations (such as the United Kingdom), which had followed the U.S. example in establishing parliamentary offices of technology assessment, did not follow the U.S. lead in abolishing these offices. Today, at least ten European nations plus the European Parliament are served by technology assessment organizations. These bodies conduct policy studies of issues raised by scientific and technological developments, many of which seek to anticipate the future impacts of technologies under development or the impacts of current societal trends. Some conduct "participatory assessments," engaging members of the public in their analyses.

OUTLOOK

'he vast amount of resources that governments, industrial firms, universities, and ther organizations worldwide are investing in research and development and ıe growing demand for technological products and technological solutions to ıe problems of poverty, illness, environmental degradation, and global insecuity virtually ensure that the rate of technological change will only accelerate in he twenty-first century. The changes will continue to pose new challenges for overnment. Some of these challenges may be foreseen; most will not. When esearchers for the U.S. Department of Defense developed a means of linking ıainframe computers at a few select laboratories in the late 1960s, no one ıvolved foresaw the immense changes their innovation, forerunner of the Interıet, would engender in publishing, commerce, entertainment, and many other ields. And no one imagined that this innovation would provide a means for ored teenagers to wreak havoc on computers halfway around the world or hat industry and government would need to spend millions of dollars protecting gainst such threats. The course that emerging technologies — nanotechnology, iotechnology, robotics, and more — will take in coming years is uncertain. Vhat is certain, however, is that the future of government and the future of echnology are inseparably linked.

BIBLIOGRAPHY

Branscomb, Lewis M., and James H. Keller, eds. *Investing in Innovation: Creating a Research and Innovation Policy That Works*. Cambridge, MA: MIT Press, 1998. An attempt to defuse the ideological arguments about government support of commercial technology.

Flamm, Kenneth. *Creating the Computer: Government, Industry, and High Technology*. Washington, DC: The Brookings Institution, 1988. Traces the roots of the various technologies that converged to make modern computers and information technology possible; documents the role of several governments, including the United States, the United Kingdom, Japan, and Germany in the development of these technologies.

Greenberg, Daniel S. *Science, Money, and Politics*. Chicago: University of Chicago Press, 2001. Although nominally about science, its interactions with government, and its ethical transgressions, this book is also relevant to government's technology policies.

Hart, David M. *Forged Consensus: Science, Technology, and Economic Policy in the United States, 1921–1953*. Princeton, NJ: Princeton University Press, 1998. Makes a strong case that the events and policy decisions of the period about which he writes continue to have a strong influence on contemporary science and technology policy.

Heimann, C. F. Larry. *Acceptable Risks: Politics, Policy, and Risky Technologies*. Ann Arbor, MI: University of Michigan Press, 1997. The politics and policy of dealing with high risk technologies and the disasters they sometimes cause, using examples from space flight and pharmaceuticals.

Kleinman, Daniel, ed. *Science, Technology, and Democracy*. Albany, NY: State University of New York Press, 2000. A collection of essays on citizen involvement in government policy making for science and technology.

Mani, Sunil. *Government, Innovation, and Technology Policy: An International Comparative Analysis*. Cheltenham, UK.: Edward Elgar, 2002. Analysis of the role of government in commercial technology development in eight countries.

Morgan, M. Granger, and Jon Peha, eds. *Science and Technology Advice for Congress*. Washington, DC: RFF Press, 2003. Papers from a conference on Congress's need for technical information and whether the Office of Technology Assessment should be resurrected to fill it.

National Research Council. *The Digital Dilemma: Intellectual Property in the Information Age*. Washington, DC: National Academies Press, 2000. An attempt to clarify the issues surrounding digitized intellectual property by a blue-ribbon committee convened by the U.S. National Academy of Sciences; includes policy and research recommendations.

Sarewitz, Daniel. *Frontiers of Illusion: Science, Technology, and the Politics of Progress*. Philadelphia: Temple University Press, 1996. A sharp critique of the myths that guide science and technology policy in the United States, by a former congressional staff member.

Stokes, Donald E. *Pasteur's Quadrant: Basic Science and Technological Innovation*. Washington, DC: Brookings Institution Press, 1997. A seminal work on the interaction of science with technology.

U.S. National Science Foundation, Division of Science Resources Statistics. *Science and Engineering Indicators — 2004*. Arlington, VA: National Science Foundation, 2004. Published every other year, this is the most comprehensive authoritative source of statistics on science and technology in the United States; the full text and tables are available online at http://www.nsf.gov/sbe/srs/seind/start.htm.

Vig, Norman J., and Herbert Paschen. *Parliaments and Technology: The Development of Technology Assessment in Europe*. Albany, NY: State University of New York Press, 1999. A unique attempt to compare technology assessment mechanisms in a number of different countries.

28

The World Is Flat

THOMAS L. FRIEDMAN

The concluding article in Technology and the Future *is largely an account of journalist Thomas Friedman's visit to a call center in Bangalore, India. By weaving together his observations of the scene there and his accounts of conversations with some of the people he meets, and placing them in the context of his acute understanding of global economic, social, and political trends, he paints a vivid picture of a world irreversibly changed by technology. The call center is located in Southern India (Bangalore is sometimes referred to as India's Silicon Valley), but from the standpoint of technology it could be anywhere on earth. What brought it to Bangalore is the confluence of talented young people willing and able to work for wages considerably lower than those in the United States or Europe, the presence of advanced telecommunications technology, and a community of motivated entrepreneurs. With his stories, Friedman illustrates how these factors are "flattening" the world—entangling the world's economies and societies with one another at a breathtaking pace.*

Thomas Friedman is a journalist and columnist with The New York Times, *for which he writes a twice-weekly column. He has written extensively on the Middle East, globalization, technology, terrorism, and climate change, as well as many other issues. In addition to* The World Is Flat: A Brief History of the Twenty-First Century, *the 2005 book from which this article is taken, he is the author of four other books. Friedman is the winner of three Pulitzer Prizes. His undergraduate degree is from Brandeis University. He also holds an M. Phil. from the University of Oxford.*

Do you know what an Indian call center sounds like?

While filming the documentary about outsourcing, the TV crew and spent an evening at the Indian-owned "24/7 Customer" call center in Bangalore.

The call center is a cross between a co-ed college frat house and a phone bank raising money for the local public TV station. There are several floors with rooms full of twenty-somethings — some twenty-five hundred in all — working the phones. Some are known as "outbound" operators, selling everything from credit cards to phone minutes. Others deal with "inbound" calls — everything from tracing lost luggage for U.S. and European airline passengers to solving computer problems for confused American consumers. The calls are transferred here by satellite and undersea fiber-optic cable. Each vast floor of a call center consists of clusters of cubicles. The young people work in little teams under the banner of the company whose phone support they are providing. So one corner might be the Dell group, another might be flying the flag of Microsoft. Their working conditions look like those at your average insurance company. Although I am sure that there are call centers that are operated like sweatshops, 24/7 is not one of them.

Most of the young people I interviewed give all or part of their salary to their parents. In fact, many of them have starting salaries that are higher than their parents' retiring salaries. For entry-level jobs into the global economy, these are about as good as it gets.

I was wandering around the Microsoft section around six p.m. Bangalore time, when most of these young people start their workday to coincide with the dawn in America, when I asked a young Indian computer expert there a simple question: What was the record on the floor for the longest phone call to help some American who got lost in the maze of his or her own software?

Without missing a beat he answered, "Eleven hours."

"Eleven hours?" I exclaimed.

"Eleven hours," he said.

I have no way of checking whether this is true, but you do hear snippets of some oddly familiar conversations as you walk the floor at 24/7 and just listen over the shoulders of different call center operators doing their things. Here is a small sample of what we heard that night while filming for Discovery Times. It should be read, if you can imagine this, in the voice of someone with an Indian accent trying to imitate an American or a Brit. Also imagine that no matter how rude, unhappy, irritated, or ornery the voices are on the other end of the line, these young Indians are incessantly and unfailingly polite.

Woman call center operator: "Good afternoon, may I speak with ...?" (Someone on the other end just slammed down the phone.)

Male call center operator: "Merchant services, this is Jerry, may I help you?" (The Indian call center operators adopt Western names of their own choosing. The idea, of course, is to make their American or European customers feel more comfortable. Most of the young Indians I talked to about this were not offended but took it as an opportunity to have some fun. While a few just opt for Susan or Bob, some really get creative.)

Woman operator in Bangalore speaking to an American: "My name is Ivy Timberwoods and I am calling you ..."

Woman operator in Bangalore getting an American's identity number: "May I have the last four digits of your Social Security?"

Woman operator in Bangalore giving directions as though she were in Man-attan and looking out her window: "Yes, we have a branch on Seventy-fourth ıd Second Avenue, a branch at Fifty-fourth and Lexington …"

Male operator in Bangalore selling a credit card he could never afford him-elf: "This card comes to you with one of the lowest APR …"

Woman operator in Bangalore explaining to an American how she screwed p her checking account: "Check number six-six-five for eighty-one dollars and fty-five cents. You will still be hit by the thirty-dollar charge. Am I clear?"

Woman operator in Bangalore after walking an American through a com-uter glitch: "Not a problem, Mr. Jassup. Thank you for your time. Take care. ye-bye."

Woman operator in Bangalore after someone has just slammed down the hone on her: "Hello? Hello?"

Woman operator in Bangalore apologizing for calling someone in America o early: "This is just a courtesy call, I'll call back later in the evening …"

Male operator in Bangalore trying desperately to sell an airline credit card to omeone in America who doesn't seem to want one: "Is that because you have o many credit cards, or you don't like flying, Mrs. Bell?"

Woman operator in Bangalore trying to talk an American out of her com-uter crash: "Start switching between memory okay and memory test …"

Male operator in Bangalore doing the same thing: "All right, then, let's just unch in three and press Enter …"

Woman operator in Bangalore trying to help an American who cannot stand eing on the help line another second: "Yes, ma'am, I do understand that you re in a hurry right now. I am just trying to help you out …"

Woman operator in Bangalore getting another phone slammed down on er: "Yes, well, so what time would be goo …"

Same woman operator in Bangalore getting another phone slammed down n her: "Why, Mrs. Kent, it's not a …"

Same woman operator in Bangalore getting another phone slammed down n her: "As a safety back … Hello?"

Same woman operator in Bangalore looking up from her phone: "I defi-itely have a bad day!"

Woman operator in Bangalore trying to help an American woman with a omputer problem that she has never heard before: "What is the problem with is machine, ma'am? The monitor is burning?"

There are currently about 245,000 Indians answering phones from all over the world or dialing out to solicit people for credit cards or cell phone bargains r overdue bills. These call center jobs are low-wage, low-prestige jobs in merica, but when shifted to India they become high-wage, high-prestige obs. The esprit de corps at 24/7 and other call centers I visited seemed quite igh, and the young people were all eager to share some of the bizarre phone onversations they've had with Americans who dialed 1-800-HELP, thinking ey would wind up talking to someone around the block, not around the orld.

C. M. Meghna, a 24/7 call center female operator, told me, "I've had lots of customers who call in [with questions] not even connected to the product that we're dealing with. They would call in because they had lost their wallet or just to talk to somebody. I'm like, 'Okay, all right, maybe you should look under the bed [for your wallet] or where do you normally keep it,' and she's like, 'Okay, thank you so much for helping.'"

Nitu Somaiah: "One of the customers asked me to marry him."

Sophie Sunder worked for Delta's lost-baggage department: "I remember this lady called from Texas," she said, "and she was, like, weeping on the phone. She had traveled two connecting flights and she lost her bag and in the bag was her daughter's wedding gown and wedding ring and I felt so sad for her and there was nothing I could do. I had no information.

"Most of the customers were irate," said Sunder. "The first thing they say is, 'Where's my bag? I want my bag now!' We were like supposed to say, 'Excuse me, can I have your first name and last name?' 'But where's my bag!' Some would ask which country am I from? We are supposed to tell the truth, [so] we tell them India. Some thought it was Indiana, not India! Some did not know where India is. I said it is the country next to Pakistan."

Although the great majority of the calls are rather routine and dull, competition for these jobs is fierce — not only because they pay well, but because you can work at night and go to school during part of the day, so they are stepping-stones toward a higher standard of living. P. V. Kannan, CEO and cofounder of 24/7, explained to me how it all worked: "Today we have over four thousand associates spread out in Bangalore, Hyderabad, and Chennai. Our associates start out with a take-home pay of roughly $200 a month, which grows to $300 to $400 per month in six months. We also provide transportation, lunch, and dinner at no extra cost. We provide life insurance, medical insurance for the entire family — and other benefits."

Therefore, the total cost of each call center operator is actually around $500 per month when they start out and closer to $600 to $700 per month after six months. Everyone is also entitled to performance bonuses that allow them to earn, in certain cases, the equivalent of 100 percent of their base salary. "Around 10 to 20 percent of our associates pursue a degree in business or computer science during the day hours," said Kannan, adding that more than one-third are taking some kind of extra computer or business training, even if it is not toward a degree. "It is quite common in India for people to pursue education through their twenties — self-improvement is a big theme and actively encouraged by parents and companies. We sponsor an MBA program for consistent performers [with] full-day classes over the weekend. Everyone works eight hours a day, five days a week, with two fifteen-minute breaks and an hour off for lunch or dinner."

Not surprisingly, the 24/7 customer call center gets about seven hundred applications a day, but only 6 percent of applicants are hired. Here is a snippet from a recruiting session for call center operators at a women's college in Bangalore:

Recruiter 1: "Good morning, girls."

Class in unison: "Good morning, ma'am."

Recruiter 1: "We have been retained by some of the multinationals here to the recruitment for them. The primary clients that we are recruiting [for] lay are Honeywell. And also for America Online."

The young women — dozens of them — then all lined up with their appli- ion forms and waited to be interviewed by a recruiter at a wooden table. Here vhat some of the interviews sounded like:

Recruiter 1: "What kind of job are you looking at?"

Applicant 1: "It should be based on accounts, then, where I can grow, I can ›w in my career."

Recruiter 1: "You have to be more confident about yourself when you're aking. You're very nervous. I want you to work a little on that and then get touch with us."

Recruiter 2 to another applicant: "Tell me something about yourself."

Applicant 2: "I have passed my SSC with distinction. Second P also with tinction. And I also hold a 70 percent aggregate in previous two years." ıis is Indian lingo for their equivalents of GPA and SAT scores.)

Recruiter 2: "Go a little slow. Don't be nervous. Be cool."

The next step for those applicants who are hired at a call center is the train- ; program, which they are paid to attend. It combines learning how to handle : specific processes for the company whose calls they will be taking or making, ı attending something called "accent neutralization class." These are daylong sions with a language teacher who prepares the new Indian hires to disguise :ir pronounced Indian accents when speaking English and replace them with nerican, Canadian, or British ones — depending on which part of the world :y will be speaking with. It's pretty bizarre to watch. The class I sat in on was ing trained to speak in a neutral middle-American accent. The students were :ed to read over and over a single phonetic paragraph designed to teach them w to soften their *t*'s and to roll their *r*'s.

Their teacher, a charming eight-months-pregnant young woman dressed in raditional Indian sari, moved seamlessly among British, American, and Cana- .n accents as she demonstrated reading a paragraph designed to highlight pho- tics. She said to the class, "Remember the first day I told you that the nericans flap the 'tuh' sound? You know, it sounds like an almost 'duh' ınd — not crisp and clear like the British. So I would not say" — here she .s crisp and sharp — "'Betty bought a bit of better butter' or 'Insert a quarter the meter.' But I would say" — her voice very flat — "'Insert a quarter in the :ter' or 'Betty bought a bit of better butter.' So I'm just going to read it out for u once, and then we'll read it together. All right? 'Thirty little turtles in a ttle of bottled water. A bottle of bottled water held thirty little turtles. It ln't matter that each turtle had to rattle a metal ladle in order to get a little of noodles.'

"All right, who's going to read first?" the instructor asked. Each member of : class then took a turn trying to say this tongue twister in an American accent. me of them got it on the first try, and others, well, let's just say that you ›uldn't think they were in Kansas City if they answered your call to Delta's t-luggage number.

After listening to them stumble through this phonetics lesson for half an hour, I asked the teacher if she would like me to give them an authentic version — since I'm originally from Minnesota, smack in the Midwest, and still speak like someone out of the movie *Fargo*. Absolutely, she said. So I read the following paragraph: "A bottle of bottled water held thirty little turtles. It didn't matter that each turtle had to rattle a metal ladle in order to get a little bit of noodles, a total turtle delicacy ... The problem was that there were many turtle battles for less than oodles of noodles. Every time they thought about grappling with the haggler turtles their little turtle minds boggled and they only caught a little bit of noodles."

The class responded enthusiastically. It was the first time I ever got an ovation for speaking Minnesotan. On the surface, there is something unappealing about the idea of inducing other people to flatten their accents in order to compete in a flatter world. But before you disparage it, you have to taste just how hungry these kids are to escape the lower end of the middle class and move up. If a little accent modification is the price they have to pay to jump a rung of the ladder, then so be it — they say.

"This is a high-stress environment," said Nilekani, the CEO of Infosys, which also runs a big call center. "It is twenty-four by seven. You work in the day, and then the night, and then the next morning." But the working environment, he insisted, "is not the tension of alienation. It is the tension of success. They are dealing with the challenges of success, of high-pressure living. It is not the challenge of worrying about whether they would have a challenge."

That was certainly the sense I got from talking to a lot of the call center operators on the floor. Like any explosion of modernity, outsourcing is challenging traditional norms and ways of life. But educated Indians have been held back so many years by both poverty and a socialist bureaucracy that many of them seem more than ready to put up with the hours. And needless to say, it is much easier and more satisfying for them to work hard in Bangalore than to pack up and try to make a new start in America. In the flat world they can stay in India, make a decent salary, and not have to be away from families, friends, food, and culture. At the end of the day, these new jobs actually allow them to be more Indian. Said Anney Unnikrishnan, a personnel manager at 24/7, "I finished my MBA and I remember writing the GMAT and getting into Purdue University. But I couldn't go because I couldn't afford it. I didn't have the money for it. Now I can, [but] I see a whole lot of American industry has come into Bangalore and I don't really need to go there. I can work for a multinational sitting right here. So I still get my rice and sambar [a traditional Indian dish], which I eat. I don't need to, you know, learn to eat coleslaw and cold beef. I still continue with my Indian food and I still work for a multinational. Why should I go to America?"

The relatively high standard of living that she can now enjoy — enough for a small apartment and car in Bangalore — is good for America as well. When you look around at 24/7's call center, you see that all the computers are running Microsoft Windows. The chips are designed by Intel. The phones are from Lucent. The air-conditioning is by Carrier, and even the bottled water is by oke. In addition, 90 percent of the shares in 24/7 are owned by U.S. investors. his explains why, although the United States has lost some service jobs to India recent years, total exports from American-based companies — merchandise id services — to India have grown from $2.5 billion in 1990 to $5 billion in 003. So even with the outsourcing of some service jobs from the United States India, India's growing economy is creating a demand for many more Ameri-in goods and services.

What goes around, comes around.

Nine years ago, when Japan was beating America's brains out in the auto industry, I wrote a column about playing the computer geography game Vhere in the World is Carmen Sandiego? with my nine-year-old daughter,)rly. I was trying to help her by giving her a clue suggesting that Carmen had one to Detroit, so I asked her, "Where are cars made?" And without missing a eat she answered, "Japan."

Ouch!

Well, I was reminded of that story while visiting Global Edge, an Indian oftware design firm in Bangalore. The company's marketing manager, Rajesh ao, told me that he had just made a cold call to the VP for engineering of a J.S. company, trying to drum up business. As soon as Mr. Rao introduced him-elf as calling from an Indian software firm, the U.S. executive said to him, *Namaste,"* a common Hindi greeting. Said Mr. Rao, "A few years ago nobody America wanted to talk to us. Now they are eager." And a few even know ow to say hello in proper Hindu fashion. So now I wonder: If I have a grand-aughter one day, and I tell her I'm going to India, will she say, "Grandpa, is iat where software comes from?"

No, not yet, honey. Every new product — from software to widgets — goes irough a cycle that begins with basic research, then applied research, then incu-ation, then development, then testing, then manufacturing, then deployment, ien support, then continuation engineering in order to add improvements. ach of these phases is specialized and unique, and neither India nor China nor ussia has a critical mass of talent that can handle the whole product cycle for a ig American multinational. But these countries are steadily developing their esearch and development capabilities to handle more and more of these phases. s that continues, we really will see the beginning of what Satyam Cherukuri, of arnoff, an American research and development firm, has called "the globalization f innovation" and an end to the old model of a single American or European iultinational handling all the elements of the development product cycle from s own resources. More and more American and European companies are out-ourcing significant research and development tasks to India, Russia, and China.

According to the information technology office of the state government in arnataka, where Bangalore is located, Indian units of Cisco Systems, Intel, BM, Texas Instruments, and GE have already filed 1,000 patent applications vith the U.S. Patent Office. Texas Instruments alone has had 225 U.S. patents warded to its Indian operation. "The Intel team in Bangalore is developing iicroprocessor chips for high-speed broadband wireless technology, to be launched in 2006," the Karnataka IT office said, in a statement issued at the end of 2004, and "at GE's John F. Welch Technology Centre in Bangalore, engineers are developing new ideas for aircraft engines, transport systems and plastics." Indeed, GE over the years has frequently transferred Indian engineers who worked for it in the United States back to India to integrate its whole global research effort. GE now even sends non-Indians to Bangalore. Vivek Paul is the president of Wipro Technologies, another of the elite Indian technology companies, but he is based in Silicon Valley to be close to Wipro's American customers. Before coming to Wipro, Paul managed GE's CT scanner business out of Milwaukee. At the time he had a French colleague who managed GE's power generator business for the scanners out of France.

"I ran into him on an airplane recently," said Paul, "and he told me he had moved to India to head up GE's high-energy research there."

I told Vivek that I love hearing an Indian who used to head up GE's CT business in Milwaukee but now runs Wipro's consulting business in Silicon Valley tell me about his former French colleague who has moved to Bangalore to work for GE. That is a flat world.

Every time I think I have found the last, most obscure job that could be outsourced to Bangalore, I discover a new one. My friend Vivek Kulkarni used to head the government office in Bangalore responsible for attracting high technology global investment. After stepping down from that post in 2003, he started a company called B2K, with a division called Brickwork, which offers busy global executives their own personal assistant in India. Say you are running a company and you have been asked to give a speech and a PowerPoint presentation in two days. Your "remote executive assistant" in India, provided by Brickwork, will do all the research for you, create the PowerPoint presentation, and e-mail the whole thing to you overnight so that it is on your desk the day you have to deliver it.

"You can give your personal remote executive assistant their assignment when you are leaving work at the end of the day in New York City, and it will be ready for you the next morning," explained Kulkarni. "Because of the time difference with India, they can work on it while you sleep and have it back in your morning." Kulkarni suggested I hire a remote assistant in India to do all the research for this book. "He or she could also help you keep pace with what you want to read. When you wake up, you will find the completed summary in your in-box." (I told him no one could be better than my longtime assistant, Maya Gorman, who sits ten feet away!)

Having your own personal remote executive assistant costs around $1,500 to $2,000 a month, and given the pool of Indian college grads from which Brickwork can recruit, the brainpower you can hire dollar-for-dollar is substantial. As Brickwork's promotional material says, "India's talent pool provides companies access to a broad spectrum of highly qualified people. In addition to fresh graduates, which are around 2.5 million per year, many qualified homemakers are entering the job market." India's business schools, it adds, produce around eighty-nine thousand MBAs per year.

"We've had a wonderful response," said Kulkarni, with clients coming from 'o main areas. One is American health-care consultants, who often need lots of ımbers crunched and PowerPoint presentations drawn up. The other, he said, : American investment banks and financial services companies, which often :ed to prepare glossy pamphlets with graphs to illustrate the benefits of an O or a proposed merger. In the case of a merger, Brickwork will prepare ose sections of the report dealing with general market conditions and trends, here most of the research can be gleaned off the Web and summarized in a ındard format. "The judgment of how to price the deal will come from the vestment bankers themselves," said Kulkarni. "We will do the lower-end ork, and they will do the things that require critical judgment and experience, ɔse to the market." The more projects his team of remote executive assistants ıgages in, the more knowledge they build up. They are full of ambition to do eir higher problem solving as well, said Kulkarni. "The idea is to constantly ırn. You are always taking an examination. There is no end to learning … here is no real end to what can be done by whom."

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WENDELL BERRY REPLIES

The foregoing letters surprised me with the intensity of the feelings they expressed. According to the writers' testimony, there is nothing wrong with their computers; they are utterly satisfied with them and all that they stand for. My correspondents are certain that I am wrong and that I am, moreover, on the losing side, a side already relegated to the dustbin of history. And yet they grow huffy and condescending over my tiny dissent. What are they so anxious about?

I can only conclude that I have scratched the skin of a technological fundamentalism that, like other fundamentalisms, wishes to monopolize a whole society and, therefore, cannot tolerate the smallest difference of opinion. At the slightest hint of a threat to their complacency, they repeat, like a chorus of toads, the notes sounded by their leaders in industry. The past was gloomy, drudgery-ridden, servile, meaningless, and slow. The present, thanks only to purchasable products, is meaningful, bright, lively, centralized, and fast. The future, thanks only to more purchasable products, is going to be even better. Thus, consumers become salesmen, and the world is made safer for corporations.

I am also surprised by the meanness with which two of these writers refer to my wife. In order to imply that I am a tyrant, they suggest by both direct statement and innuendo that she is subservient, characterless, and stupid — a mere "device" easily forced to provide meaningless "free labor." I understand that it is impossible to make an adequate public defense of one's private life, and so I will only point out that there are a number of kinder possibilities that my critics have disdained to imagine: that my wife may do this work because she wants to and likes to, that she may find some use and some meaning in it, that she may not work for nothing. These gentlemen obviously think themselves feminists of the most correct and principled sort, and yet they do not hesitate to stereotype and insult, on the basis of one fact, a woman they do not know. They are audacious and irresponsible gossips.

In his letter, Bradley C. Johnson rushes past the possibility of sense in what I said in my essay by implying that I am or ought to be a fanatic. That I am a person of this century and implicated in many practices that I regret is fully acknowledged at the beginning of my essay. I did not say that I proposed to end forthwith all my involvement in harmful technology, for I do not know how to do that. I said merely that I want to limit such involvement and to a certain extent I do know how to do that. If some technology does damage to the world — as two of [these] letters seem to agree that it does — then why is it not reasonable, and indeed moral, to try to limit one's use of that technology? Of course, I think that I am right to do this.

I would not think so, obviously, if I agreed with Nathaniel S. Borenstein that "'better' is in the mind of the beholder." But if he truly believes this, I do not see why he bothers with his personal computer's "up-to-the-minute reports on the workings of the EPA and the nuclear industry" or why he wishes to be warned about "urgent legislative issues." According to his system, the "better" in a bureaucratic, industrial, or legislative mind is as good as the "better" in his. His mind apparently is being subverted by an objective standard of some sort, and he had better look out.

Borenstein does not say what he does after his computer has drummed him awake. I assume from his letter that he must send donations to conservation organizations and letters to officials. Like James Rhoads, at any rate, he has a clear conscience. But this is what is wrong with the conservation movement. It has a clear conscience. The guilty are always other people, and the wrong is always somewhere else; that is why Borenstein finds his "electronic bulletin board" so handy. To the conservation movement, it is only production that causes environmental degradation; the consumption that supports the production is rarely acknowledged to be at fault. The ideal of the run-of-the-mill conservationist is to impose restraints upon production without limiting consumption or burdening the consciences of consumers.

But virtually all of our consumption now is extravagant, and virtually all of it consumes the world. It is not beside the point that most electrical power comes from strip-mined coal. The history of the exploitation of the Appalachian coal fields is long, and it is available to readers. I do not see how anyone can read it and plug in any appliance with a clear conscience. If Rhoads can do so, that does not mean that his conscience is clear; it means that his conscience is not working.

To the extent that we consume, in our present circumstances, we are guilty. To the extent that we guilty consumers are conservationists, we are absurd. But what can we do? Must we go on writing letters to politicians and donating to conservation organizations until the majority of our fellow citizens agree with us? Or can we do something directly to solve our share of the problem?

I am a conservationist. I believe wholeheartedly in putting pressure on the politicians and in maintaining the conservation organizations. But I wrote my little essay partly in distrust of centralization. I don't think that the government and the conservation organizations alone will ever make us a conserving society. Why do I need a centralized computer system to alert me to environmental crises? That I live every hour of every day in an environmental crisis I know from all my senses. Why then is not my first duty to reduce, so far as I can, my own consumption?

Finally, it seems to me that none of my correspondents recognizes the innovativeness of my essay. If the use of a computer is a new idea, then a newer idea is not to use one.

23

Computer Ethics

DEBORAH G. JOHNSON

The many roles that computers play in society raise a host of ethical and legal issues: privacy, cybercrime, ownership of intellectual property, liability for damages, accountability, and more. But to what extent are these issues unique to computers, and to what extent are they simply new areas of application for well-established ethical and legal principles? Many of these issues have developed as computers and their uses have grown and permeated society. The advent of the Internet has intensified issues of computer ethics and created new and more complex ones. And, as computer technology continues to evolve, new and more difficult ethical issues are likely to arise. Deborah Johnson, one of the most respected voices in this area, probes the field of computer ethics in a systematic manner that provides an effective introduction and a set of guideposts to structure our thinking about its many dimensions.

Deborah Johnson is chair of the Department of Science, Technology, and Society and Anne Shirley Carter Olsson Professor of Applied Ethics in the School of Engineering and Applied Science at the University of Virginia. Johnson holds a Ph.D. in philosophy from the University of Kansas and has taught at Rensselaer Polytechnic Institute and Georgia Institute of Technology. She is the author or editor of several books, including Computer Ethics, *the third edition of which was published in 2001, and many articles. This essay appeared first as a chapter in* The Blackwell Guide to the Philosophy of Computing and Information *(2003), edited by Luciano Floridi.*

Deborah G. Johnson, "Computer Ethics" from *The Blackwell Guide to the Philosophy of Computing and Information*, ed. Luciano Floridi.

INTRODUCTION

rom the moment of their invention, computers have generated complex social, ethical, and value concerns. These concerns have been expressed in a ariety of ways, from the science fiction stories of Isaac Asimov (1970) to a dense iree-volume treatise on social theory by Manuel Castells (1996, 1997, 1998), ıd with much in between. Generally, the literature describes the social conseuences of computing, speculates on the meaning of computation and informaon technology in human history, and creatively predicts the future path of evelopment of computer technology and social institutions around it. A small, ıough steadily increasing, number of philosophers has focused specifically on ıe *ethical issues.*

As computer technology evolves and gets deployed in new ways, certain sues persist — issues of privacy, property rights, accountability, and social alues. At the same time, seemingly new and unique issues emerge. The ethical sues can be organized in at least three different ways: according to the type of chnology; according to the sector in which the technology is used; and accordıg to ethical concepts or themes. In this chapter I will take the third approach. lowever, before doing so it will be useful to briefly describe the other two pproaches.

The first is to organize the ethical issues by type of technology and its use. Vhen computers were first invented, they were understood to be essentially ophisticated calculating machines, but they seemed to have the capacity to do ıat which was thought to be uniquely human — to reason and exhibit a high egree of rationality; hence, there was concern that computers threatened ideas bout what it means to be human. In the shadow of the Second World War, oncerns quickly turned to the use of computers by governments to centralize ıd concentrate power. These concerns accompanied the expanding use of computers for record-keeping and the exponential growth in the scale of databases, lowing the creation, maintenance, and manipulation of huge quantities of peronal information. This was followed by the inception of software control systems ıd video games, raising issues of accountability — liability and property rights. his evolution of computer technology can be followed through to more recent evelopments including the Internet, simulation and imaging technologies, and irtual reality systems. Each one of these developments was accompanied by coneptual and moral uncertainty. What will this or that development mean for the ves and values of human beings? What will it do to the relationship between overnment and citizen? Between employer and employee? Between businesses ıd consumers?

A second enlightening approach is to organize the issues according to the ector in which they occur. Ethical issues arise in real-world contexts, and omputer-ethical issues arise in the contexts in which computers are used. Each ontext or sector has distinctive issues, and if we ignore this context we can miss nportant aspects of computer-ethical issues. For example, in dealing with privacy rotection in general, we might miss the special importance of privacy protection or *medical records* where confidentiality is so essential to the doctor–patient elationship. Similarly, one might not fully understand the appropriate role for computers in education were one not sensitive to distinctive goals of education.

Both of these approaches — examining issues by types and uses of particular echnologies, and sector by sector — are important and illuminating; however, hey take us too far afield of the philosophical issues. The third approach — the approach to be taken in this chapter — is to emphasize ethical concepts and hemes that persist across types of technology and sectors. Here the issues are sorted by their philosophical and ethical content. In this chapter I divide the ssues into two broad categories: (1) metatheoretical and methodological issues, and (2) traditional and emerging issues.

METATHEORETICAL AND METHODOLOGICAL ISSUES

Perhaps the deepest philosophical thinking on computer-ethical issues has been reflection on the field itself — its appropriate subject matter, its relationship to other fields, and its methodology. In a seminal piece entitled "What is Computer Ethics?" Moor (1985) recognized that when computers are first introduced into an environment, they make it possible for human beings (individuals and institutions) to do things they couldn't do before, and this creates *policy vacuums*. We do not have rules, policies, and conventions on how to behave with regard to the new possibilities. Should employers monitor employees to the extent possible with computer software? Should doctors perform surgery remotely? Should I make copies of proprietary software? Is there any harm in me taking on a pseudo-identity in an online chatroom? Should companies doing business online be allowed to sell the transaction-generated information they collect? These are examples of policy vacuums created by computer technology.

Moor's account of computer ethics has shaped the field of computer ethics with many computer ethicists understanding their task to be that of helping to fill policy vacuums. Indeed, one of the topics of interest in computer ethics is to understand this activity of filling policy vacuums. This will be addressed later on.

The Connection Between Technology and Ethics

While Moor's account of computer ethics remains influential, it leaves several questions unanswered. Hence, discussion and debate continue around the question of why there is or should be a field of computer ethics and what the focus of the field should be.

In one of the deeper analyses, Floridi (1999) argues for a metaphysical foundation for computer ethics. He provides an account of computer ethics in which information has status such that destroying information can itself be morally wrong. In my own work I have tried to establish the foundation of computer ethics in the nonobvious connection between technology and ethics (Johnson 2001).

Why is technology of relevance to ethics? What difference can technology make to human action? To human affairs? To moral concepts or theories?

Two steps are involved in answering these questions. The first step involves fully recognizing something that Moor's account acknowledges, namely that technology often makes it possible for human beings to do what they could not do without it. Think of spaceships that take human beings to the moon; think of imaging technology that allows us to view internal organs; or think of computer viruses that wreak havoc on the Internet.

Of course, it is not just that human beings can do what they couldn't do before. It is also that we can do the same sorts of things we did before, only in new ways. As a result of technology, we can travel, work, keep records, be entertained, communicate, and engage in warfare *in new ways*. When we engage in these activities using computer technology, our actions have different properties, properties that may change the character of the activity or action-type. Consider the act of writing with various technologies. When I write with paper and pencil, the pencil moves over paper; when I write using a typewriter, levers and gears move; when I write using a computer, electronic impulses change configurations in microchips. So, the physical events that take place when I write are very different when I use computer technology.

Using action theory, the change can be characterized as a change in the possible act tokens of an act type. An act type is a kind of action (e.g. reading a book, walking) and an act token is a particular instance of an act type. An act token is an instance of the act type performed by a particular person, at a particular time, and in a particular place. For example, "Jan is, at this moment, playing chess with Jim in Room 200 of Thornton Hall on the campus of the University of Virginia" is an act token of the act type "playing chess." When technology is involved in the performance of an act type, a new set of act tokens may become possible. It is now possible, for example, to "play chess" while sitting in front of a computer and not involving another human being. Instead of manually moving three-dimensional pieces, one presses keys on a keyboard or clicks on a mouse. Thus, when human beings perform actions with computers, new sets of tokens (of act types) become possible. Most important, the new act tokens have properties that are distinct from other tokens of the same act type.

Computer technology instruments human action in ways that turn very simple movements into very powerful actions. Consider hardly-visible finger movements on a keyboard. When the keyboard is connected to a computer and the computer is connected to the Internet, and when the simple finger movements create and launch a computer virus, those simple finger movements can wreak havoc in the lives of thousands (even millions) of people. The technology has instrumented an action not possible without it. To be sure, individuals could wreak havoc on the lives of others before computer technology, but not in this way and perhaps not quite so easily. Computer technology is not unique among technologies in this respect; other technologies have turned simple movements of the body into powerful actions, e.g., dynamite, automobiles.

Recognizing the intimate connection between technology and human action is important for stopping the deflection of human responsibility in technology-instrumented activities, especially when something goes wrong. Hence, the hacker cannot avoid responsibility for launching a virus on grounds that he simply moved his fingers while sitting in his home. Technology does nothing independent of human initiative; though, of course, sometimes human beings cannot foresee what it is they are doing with technology.

Thus, the first step in understanding the connection between computer technology and ethics is to acknowledge how intimate the connection between (computer) technology and human action can be. The second step is to connect human action to ethics. This step may seem too obvious to be worthy of mention since ethics is often understood to be exclusively the domain of human action. Even so, computer technology changes the domain of human action; hence, it is worth asking whether these changes have moral significance. Does the involvement of computer technology — in a human situation — have moral significance? Does the *instrumentation* of human action affect the character of ethical issues, the nature of ethical theory, or ethical decision-making?

The involvement of computer technology has moral significance for several reasons. As mentioned earlier, technology creates new possibilities for human action and this means that human beings face ethical questions they never faced before. Should we develop biological weapons and risk a biological war? Should I give my organs for transplantation? In the case of computer technology, is it wrong to monitor keystrokes of employees who are using computers? To place cookies on computers when the computers are used to visit a website? To combine separate pieces of personal data into a single comprehensive portfolio of a person?

When technology changes the properties of tokens of an act type, the moral character of the act type can change. In workplace monitoring, for example, while it is generally morally acceptable for employers to keep track of the work of employees, the creation of software that allows the employer to record and analyze every keystroke an employee makes raises the question in a new way. The rights of employers and employees have to be reconsidered in light of this new possibility. Or to use a different sort of example, when it comes to property rights in software, the notion of property and the stakes in owning and copying are significantly different when it comes to computer software because computer software has properties unlike that of anything else. Most notably, software can be replicated with no loss to the owner in terms of possession or usefulness (though, of course, there is a loss in the value of the software in the marketplace).

So, computers and ethics are connected insofar as computers make it possible for humans to do things they couldn't do before and to do things they could do before but in new ways. These changes often have moral significance.

APPLIED AND SYNTHETIC ETHICS

To say that computer technology creates new tokens of an act type may lead some to categorize computer ethics as a branch of applied or practical ethics. Once a computer ethical issue is understood to involve familiar act types, it ıight be presumed, all that is necessary to resolve the issue is to use moral princiles and theories that generally apply to the act type. For example, if the situation ıvolves honesty in communicating information, simply follow the principle, "tell ıe truth," with all its special conditions and caveats. Or, if the situation involves roducing some positive and negative effects, simply do the utilitarian calculation. 'his account of computer ethics is, however, as controversial as is the notion of applied ethics" more generally.

For one thing, computer technology and the human situations arising round it are not always so easy to understand. As Moor has pointed out, often ıere are conceptual muddles (1985). What is software? What is a computer irus? How are we to conceptualize a search engine? A cookie? A virtual harm? n other words, computer ethicists do more than "apply" principles and theories; ıey do conceptual analysis. Moreover, the analysis of a computer-ethical issue ften involves synthesis, synthesis that creates an understanding of both the techology and the ethical situation. A fascinating illustration of this is the case of a irtual rape (Dibbell 1993). Here a character in a multi-user virtual reality game ıpes another character. Those participating in the game are outraged and conder the behavior of the real person controlling the virtual characters offensive nd bad. The computer ethical issue involves figuring out what, if anything, vrong the real person controlling the virtual character has done. This involves nderstanding how the technology works, what the real person did, figuring out ow to characterize the actions, and then recommending how the behavior ıould be viewed and responded to. Again, analysis of this kind involves more ıan simply "applying" principles and theories. It involves conceptual analysis nd interpretation. Indeed, the synthetic analysis may have implications that eflect back on the meaning of, or our understanding of, familiar moral principles nd theories.

To be sure, philosophical work in computer ethics often does involve rawing on and extending the work of well-known philosophers and making se of familiar moral concepts, principles, and theories. For example, computer thical issues have frequently been framed in utilitarian, deontological, and ocial contract theory. Many scholars writing about the Internet have drawn n the work of existentialist philosophers such as Søren Kierkegaard (Dreyfus 999; Prosser and Ward 2000) and Gabriel Marcel (Anderson 2000). The work f Jürgen Habermas has been an important influence on scholars working on omputer-mediated communication (Ess 1996). Recently van den Hoven 1999) has used Michael Walzer's "spheres of justice" to analyze the informaon society; Cohen (2000) and Introna (2001) have used Emmanuel Levinas to nderstand Internet communication; Adams and Ofori-Amanfo (2000) have een connecting feminist ethics to computer ethics; and Grodzinsky (1999) as developed virtue theory to illuminate computer ethics.

Nevertheless, while computer ethicists often draw on, extend, and "apply" ıoral concepts and theories, computer ethics involves much more than this. Brey (2000) has recently argued for an approach that he labels "disclosive computer ethics." The applied ethics model, he notes, emphasizes controversial issues or which the ethical component is transparent. Brey argues that there are many nontransparent issues, issues that are not so readily recognized. Analysis must be done to "disclose" and make visible the values at stake in the design and use of computer technology. A salient example here is work by Introna and Nissenbaum (2000) on search engines. They show how the design of search engines is laden with value choices. In order to address those value choices explicitly, the values embedded in search engine design must be uncovered and disclosed. This may sound simple, but in fact uncovering the values embedded in technology involves understanding how the technology works and how it affects human behavior and human values.

Setting aside what is the best account of computer ethics, it should be clear that a major concern of the field is to understand its domain, its methodology, its reason for being, and its relationship to other areas of ethical inquiry. As computer technology evolves and gets deployed in new ways, more and more ethical issues are likely to arise.

TRADITIONAL AND EMERGING ISSUES

"Information society" is the term often used (especially by economists and sociologists) to characterize societies in which human activity and social institutions have been significantly transformed by computer and information technology. Using this term, computer ethics can be thought of as the field that examines ethical issues distinctive to "an information society." Here I will focus on a subset of these issues, those having to do with professional ethics, privacy, cyber crime, virtual reality, and general characteristics of the Internet.

Ethics for Computer Professionals

In an information society, a large number of individuals are educated for and employed in jobs that involve development, maintenance, buying and selling, and use of computer and information technology. Indeed, an information society is dependent on such individuals — dependent on their special knowledge and expertise and on their fulfilling correlative social responsibilities. Expertise in computing can be deployed recklessly or cautiously, used for good or ill, and the organization of information technology experts into occupations/professions is an important social means of managing that expertise in ways that serve human well-being.

An important philosophical issue here has to do with understanding and justifying the social responsibilities of computer experts. Recognizing that justification of the social responsibilities of computer experts is connected to more general notions of duty and responsibility, computer ethicists have drawn on a variety of traditional philosophical concepts and theories, but especially social contract theory.

Notice that the connection between being a computer expert and having a duty to deploy that expertise for the good of humanity cannot be explained simply as a causal relationship. For one thing, one can ask "why?" Why does the role of computer expert carry with it social responsibilities? For another, individuals acting in occupational roles are typically not acting simply as individual autonomous moral agents; they act as employees of companies or agencies, and may not be involved in the decisions that most critically determine project outcomes. Hence, there is a theoretical problem in explaining why and to what extent individuals acting in occupational roles are responsible for the effects of their work.

Social contract theory provides an account of the connection between occupational roles and social responsibilities. A social contract exists between members of an occupational group and the communities or societies of which they are a part. Society (states, provinces, communities) allows occupational groups to form professional organizations, to make use of educational institutions to train their members, to control admission, and so on, but all of this is granted in exchange for a commitment to organize and control the occupational group in ways that benefit society. In other words, a profession and its members acquire certain privileges in exchange for accepting certain social responsibilities.

The substantive content of those responsibilities has also been a topic of focus for computer ethicists. Computer professional groups have developed and promulgated codes of professional and ethical conduct that delineate in broad terms what is and is not required of computer experts. See, for example, the ACM [Association for Computing Machinery — the premier membership organization for computer professionals] Code of Ethics and Professional Conduct or the Code of Conduct of the British Computer Society. Since these codes are very general, there has been a good deal of discussion as to their appropriate role and unction. Should they be considered comparable to law? Should there be enforcement mechanisms and sanctions for those who violate the code? Or should codes of conduct aim at inspiration? If so, then they should merely consist of a statement of ideals and need not be followed "to the letter" but only in spirit.

At least one computer ethicist has gone so far as to argue that the central task f the field of computer ethics is to work out issues of professional ethics for omputer professionals. Gotterbarn (1995: 21) writes that the "only way to ake sense of 'Computer Ethics' is to narrow its focus to those actions that are ithin the control of the individual *moral* computer professional."

While Gotterbarn's position is provocative, it is not at all clear that it is right. or one thing, many of the core issues in computer ethics are social value and olicy issues, such as privacy and property rights. These are issues for all citizens, ot just computer professionals. Moreover, many of the core issues faced by mputer professionals are not unique to computing; they are similar to issues ing other occupational groups: What do we owe our clients? Our employers? hen are we justified in blowing the whistle? How can we best protect the blic from risk? Furthermore, since many computer professionals work in prie industry, many of the issues they face are general issues of business ethics. ey have to do with buying and selling, advertising, proprietary data, competi- practices, and so on. Thus, it would be a mistake to think that all of the ical issues surrounding computer and information technology are simply ethiissues for computer professionals. Computer experts face many complex and distinctive issues, but these are only a subset of the ethical issues surrounding computer and information technology.

Privacy

In an "information society" privacy is a major concern in that much (though by no means all) of the information gathered and processed is information about individuals. Computer technology makes possible a previously unimaginable magnitude of data collection, storage, retention, and exchange. Indeed, computer technology has made information collection a built-in feature of many activities, for example, using a credit card, making a phone call, browsing the web. Such information is often referred to as transaction-generated information or TGI.

Computer ethicists often draw on prior philosophical and legal analysis of privacy and focus on two fundamental questions: What is privacy? Why is it of value? These questions have been contentious and privacy often appears to be an elusive concept. Some argue that privacy can be reduced to other concepts such as property or liberty; some argue that privacy is something in its own right and that it is intrinsically valuable; yet others argue that while not intrinsically valuable, privacy is instrumental to other things that we value deeply — friendship, intimacy, and democracy.

Computer ethicists have taken up privacy issues in parallel with more popular public concerns about the social effects of so much personal information being gathered and exchanged. The fear is that an "information society" can easily become a "surveillance society." Here computer ethicists have drawn on the work of Bentham and Foucault suggesting that all the data being gathered about individuals may create a world in which we effectively live our daily lives in a panopticon (Reiman 1995). "Panopticon" is the shape of a structure that Jeremy Bentham designed for prisons. In a panopticon, prison cells are arranged in a circle with the inside wall of each cell made of glass so that a guard, sitting in a guard tower situated in the center of the circle, can see everything that happens in each and every cell. The effect is not two-way; that is, the prisoners cannot see the guard in the tower. In fact, a prison guard need not be in the guard tower for the panopticon to have its effect; it is enough that prisoners believe they are being watched. When individuals believe they are being watched, they adjust their behavior accordingly; they take into account how the watcher will perceive their behavior. This influences individual behavior and how individuals see themselves.

While computerized information-gathering does not physically create the structure of a panopticon, it does something similar insofar as it makes a good deal of individual behavior available for observation. Thus, data collection activities of an information society could have the panopticon effect. Individuals would know that most of what they do can be observed and this could influence how they behave. When human behavior is monitored, recorded, and tracked, individuals could become intent on conforming to norms for fear of negative consequences. If this were to happen to a significant extent, it might incapacitate individuals in acting freely and thinking critically — capacities necessary to alize democracy. In this respect, the privacy issues around computer technolgy go to the heart of freedom and democracy.

It might be argued that the panoptic effect will not occur in information ocieties because data collection is invisible so that individuals are unaware they e being watched. This is a possibility, but it is also possible that as individuals ecome more and more accustomed to information societies, they will become ore aware of the extent to which they are being watched. They may come to e how information gathered in various places is put together and used to make ecisions that affect their interactions with government agencies, credit bureaus, isurance companies, educational institutions, employers, etc.

Concerns about privacy have been taken up in the policy arena, with a variety f legislation controlling and limiting the collection and use of personal data. An nportant focus here has been comparative analyses of policies in different counies — for they vary a good deal. The American approach has been piecemeal, ith separate legislation for different kinds of records (i.e., medical records, nployment histories, credit records), whereas several European countries have omprehensive policies that specify what kind of information can be collected nder what conditions in *all* domains. Currently the policy debates are pressured y the intensification of global business. Information-gathering organizations romise data subjects that they will only use information in certain ways; yet, in global economy, data collected in one country — with a certain kind of data rotection — can flow to another country where there is no or different protecon. An information-gathering organization might promise to treat information in certain way, and then send the information abroad where it is treated in a ompletely different way, thus breaking the promise made to the data subject. o assure that this does not happen, a good deal of attention is currently being ocused on working out international arrangements and agreements for the flow f data across national boundaries.

Cybercrime and Abuse

While the threats to privacy described above arise from *uses* of computer and iformation technology, other threats arise from *abuses*. As individuals and compaies do more and more electronically, their privacy and property rights become ver more important, and these rights are sometimes threatened by individuals ho defy the law or test its limits. Such individuals may seek personal gain or ay just enjoy the challenge of figuring out how to *crack* security mechanisms. hey are often called *hackers* or *crackers*. The term *hacker* used to refer to individuals ho simply loved the challenge of working on programs and figuring out how to o complex things with computers, but did not necessarily break the law. *Crackers* ere those who broke the law. However, the terms are now used somewhat iterchangeably to refer to those who engage in criminal activity.

The culture of hackers and crackers has been of interest not only because of ie threat posed by their activities, but also because the culture of hackers and ackers represents an alternative vision of how computer technology might be eveloped and used, one that has intrigued philosophers. Hackers and crackers often defend their behavior by arguing for a much more open system of computing with a freer flow of information, creating an environment in which individuals can readily share tools and ideas. In particular, the culture suggests that a policy of no ownership of software might lead to better computing. This issue goes to the heart of philosophical theories of property, raising traditional debates about the foundations of property, especially intellectual property.

Some draw on Locke's labor theory of property and argue that software developers have a natural right to control the use of their software. Others, such as me, argue that while there are good utilitarian reasons for granting ownership in software, natural rights arguments do not justify private ownership of software (Johnson 2001). There is nothing inherently unfair about living in a world in which one does not own and cannot control the use of software one has created.

Nevertheless, currently, in many industrialized countries there are laws against copying and distributing proprietary software, and computer ethicists have addressed issues around violations of these laws. Conceptually, some have wondered whether there is a difference between familiar crimes such as theft or harassment and parallel crimes done using computers. Is there any morally significant difference between stealing (copying and selling copies of) a software program and stealing a car? Is harassment via the Internet morally any different than face-to-face harassment? The question arises because actions and interactions on the Internet have some distinguishing features. On the Internet, individuals can act under the shroud of a certain kind of anonymity. They can disguise themselves through the mediation of computers. This together with the reproducibility of information in computer systems makes for a distinctive environment for criminal behavior. One obvious difference in cybertheft is that the thief does not deprive the owner of the use of the property. The owner still has access to the software, though of course the market value of the software is diminished when there is rampant copying.

Computer ethicists have taken up the task of trying to understand and conceptualize cybercrimes as well as determining how to think about their severity and appropriate punishment. Criminal behavior is nothing new, but in an information society new types of crimes are made possible, and the actions necessary to catch criminals and prevent crimes are different.

Internet Issues

Arguably the Internet is the most powerful technological development of the late twentieth century. The Internet brings together many industries, but especially the computer, telecommunications, and media enterprises. It brings together and provides a forum for millions of individuals and businesses around the world. It is not surprising, then, that the Internet is currently a major focus of attention for computer ethicists. The development of the Internet has involved moving many basic social institutions from a paper and ink medium to the electronic medium. The question for ethicists is this: is there anything ethically distinctive about the Internet? (A parallel question was asked in the last section with regard to cybercrime.)

The Internet seems to have three features that make it unusual or special. First, it has an unusual scope in that it provides many-to-many communication on a global scale. Of course, television and radio as well as the telephone are global in scale, but television and radio are one-to-many forms of communication, and the telephone, which is many-to-many, is expensive and more difficult to use. With the Internet, individuals and companies can have much more frequent communication with one another, in real time, at relatively low cost, with ease and with visual as well as sound components. Second, the Internet facilitates a certain kind of anonymity. One can communicate extensively with individuals across the globe (with ease and minimal cost), using pseudonyms or real identities, and yet one never has to encounter the others face-to-face. This type of anonymity affects the content and nature of the communication that takes place on the Internet. The third special feature of the Internet is its reproducibility. When put on the Internet, text, software, music, and video can be duplicated *ad infinitum.* They can also be altered with ease. Moreover, the reproducibility of the medium means that all activity on the Internet is recorded and can be traced.

These three features of the Internet — global many-to-many scope, anonymity, and reproducibility — have enormous positive as well as negative potential. The global, many-to-many scope can bring people from around the globe closer together, relegating geographic distance to insignificance. This feature is especially freeing to those for whom travel is physically challenging or inordinately expensive. At the same time, these potential benefits come with drawbacks; one of the drawbacks is that this power also goes to those who would use it for heinous purposes. Individuals can — while sitting anywhere in the world, with very little effort — launch viruses and disrupt communication between others. They can misrepresent themselves and dupe others on a much larger scale than before the Internet.

Similarly, anonymity has both benefits and dangers. The kind of anonymity available on the Internet frees some individuals by removing barriers based on physical appearance. For example, in contexts in which race and gender may get in the way of fair treatment, the anonymity provided by the Internet can eliminate bias; for example, in on-line education, race, gender, and physical appearance are removed as factors affecting student-to-student interactions as well as the teacher evaluations of students. Anonymity may also facilitate participation in beneficial activities such as discussions among rape victims or battered wives or ex-cons where individuals might be reluctant to participate unless they had anonymity.

Nevertheless, anonymity leads to serious problems of accountability and for the integrity of information. It is difficult to catch criminals who act under the shroud of anonymity. And anonymity contributes to the lack of integrity of electronic information. Perhaps the best illustration of this is information one acquires in chatrooms on the Internet. It is difficult (though not impossible) to be certain of the identities of the persons with whom one is chatting. The same person may be contributing information under multiple identities; multiple individuals may be using the same identity; participants may have vested interests in the information being discussed (e.g., a participant may be an employee of the company/product being discussed). When one can't determine the real source of information or develop a history of experiences with a source, it is impossible to gauge the trustworthiness of the information.

Like global scope and anonymity, reproducibility also has benefits and dangers. Reproducibility facilitates access to information and communication; it allows words and documents to be forwarded (and downloaded) to an almost infinite number of sites. It also helps in tracing cybercriminals. At the same time, however, reproducibility threatens privacy and property rights. It adds to the problems of accountability and integrity of information arising from anonymity. For example, when I am teaching a class, students can now send their assignments to me electronically. This saves time, is convenient, saves paper, etc. At the same time, however, the reproducibility of the medium raises questions about the integrity of the assignments. How can I be sure the student wrote the paper and didn't download it from the web?

When human activities move to the Internet, features of these activities change and the changes may have ethical implications. The Internet has led to a wide array of such changes. The task of computer ethics is to ferret out these changes and address the policy vacuums they create.

Virtual Reality

One of the most philosophically intriguing capacities of computer technology is "virtual reality systems." These are systems that graphically and aurally represent environments, environments into which individuals can project themselves and interact. Virtual environments can be designed to represent real-life situations and then used to train individuals for those environments, e.g., pilot training programs. They can also be designed to do just the opposite, that is, to create environments with features radically different from the real world, e.g., fantasy games. Ethicists have just begun to take up the issues posed by virtual reality, and the issues are deep (Brey 1999). The meaning of actions in virtual reality is what is at stake as well as the moral accountability of individual behavior in virtual systems. When one acts in virtual systems one "does" something, though it is not the action represented. For example, killing a figure in a violent fantasy game is not the equivalent of killing a real person. Nevertheless, actions in virtual systems can have real-world consequences; for example, violence in a fantasy game may have an impact on the real player or, as another example, the pilot flying in the flight simulator may be judged unprepared for real flight. As human beings spend more and more time in virtual systems, ethicists will have to analyze what virtual actions mean and what, if any, accountability individuals bear for their virtual actions.

CONCLUSION

This chapter has covered only a selection of the topics addressed by philosophers working in the field of computer ethics. Since computers and information technology are likely to continue to evolve and become further integrated into the human and natural world, new ethical issues are likely to arise. On the other hand, as we become more and more accustomed to acting with and through computer technology, the difference between "ethics" and "computer ethics" may well disappear.

REFERENCES

dams, A. and Ofori-Amanfo, J. 2000. "Does gender matter in computer ethics?" *Ethics and Information Technology* 2(1): pp. 37–47.

nderson, T. C. 2000. "The body and communities in cyberspace: a Marcellian analysis." *Ethics and Information Technology* 2(3): pp. 153–8.

simov, I. 1970. *I, Robot*. Greenwich, CT: Fawcett Publications.

rey, P. 1999. "The ethics of representation and action in virtual reality." *Ethics and Information Technology* 1(1): pp. 5–14.

rey, P. 2000. "Disclosive computer ethics." *Computers & Society*, Dec.: pp. 10–16.

astells, M. 1996. *The Rise of the Network Society*. Malden, MA: Blackwell Publishers.

——— 1997. *The Power of Identity*. Malden, MA: Blackwell Publishers.

——— 1998. *The End of Millennium*. Malden, MA: Blackwell Publishers.

ohen, R. A. 2000. "Ethics and cybernetics: Levinasian reflections." *Ethics and Information Technology* 2(1): pp. 27–35.

ibbell, J. 1993. "A rape in cyberspace: how an evil clown, a Haitian trickster spirit, two wizards, and a cast of dozens turned a database into a society." *The Village Voice*, Dec. 23: pp. 36–42.

reyfus, H. L. 1999. "Anonymity versus commitment: the dangers of education on the Internet." *Ethics and Information Technology* 1(1): pp. 15–21.

ss, C., ed. 1996. *Philosophical Perspectives on Computer-Mediated Communication*. Albany: State University of New York Press.

loridi, L. 1999. "Information ethics: on the philosophical foundation of computer ethics." *Ethics and Information Technology* 1(1): pp. 37–56.

otterbarn, D. 1995. "Computer ethics: responsibility regained." In D. G. Johnson and H. Nissenbaum, eds., *Computers, Ethics and Social Values*. Englewood Cliffs, NJ: Prentice Hall, pp. 18–24.

rodzinsky, F. S. 1999. "The practitioner from within: revisiting the virtues." *Computers & Society* 29(1): pp. 9–15.

trona, L. D. 2001. "Virtuality and morality." *Philosophy in the Contemporary World* 8(1): pp. 31–39.

——— and Nissenbaum, H. 2000. "Shaping the web: why the politics of search engines matters." *The Information Society* 16(3): pp. 169–85.

hnson, D. G. 2001. *Computer Ethics*, 3rd ed. Upper Saddle River, NJ: Prentice Hall.

loor, J. 1985. "What is computer ethics?" *Metaphilosophy* 16(4): pp. 266–75.

rosser, B. T. and Ward, A. 2000. "Kierkegaard and the Internet: existential reflections on education and community." *Ethics and Information Technology* 2(3): pp. 167–80.

eiman, J. H. 1995. "Driving to the panopticon: a philosophical exploration of the risks to privacy posed by the highway technology of the future." *Computer and High Technology Law Journal* 11: pp. 27–44.

an den Hoven, J. 1999. "Privacy and the varieties of informational wrongdoing." *Australian Journal of Professional and Applied Ethics* 1(1): pp. 30–43.

24

Is Google Making Us Stupid? What the Internet Is Doing to Our Brains

NICHOLAS CARR

Marshall McLuhan's pioneering study, Understanding Media: The Extensions of Man, *was one of the most talked-about books of the 1960s. McLuhan proposed that it was the media themselves, rather than their content, that shaped human consciousness and, by extension, human society. McLuhan was writing about television, radio, film, newspapers, and other media of that era. The Internet was still years away.*

Today the Internet is arguably the dominant medium and its influence on us and our society is even more profound than the media of McLuhan's era. In the following essay, which appeared first in The Atlantic, *Nicholas Carr explores the nature of that influence. The Net, he claims, has changed the way we relate to and absorb information, the way we think. The price we pay for having instant access to the rich store of information available today is a loss in our ability to concentrate and focus. Will we be better off as a result of having the world of information literally at our fingertips? Carr is not sure. This essay does not answer the question that its title asks metaphorically. But it gives us pause and, perhaps, a chance to stop and think about where this uniquely influential technology is leading us.*

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"Dave, stop. Stop, will you? Stop, Dave. Will you stop, Dave?" So the supercomputer HAL pleads with the implacable astronaut Dave Bowman in a famous and weirdly poignant scene toward the end of Stanley Kubrick's *2001: A Space Odyssey*. Bowman, having nearly been sent to a deep-space death by the malfunctioning machine, is calmly, coldly disconnecting the memory circuits that control its artificial "brain." "Dave, my mind is going," HAL says, forlornly. "I can feel it. I can feel it."

I can feel it, too. Over the past few years I've had an uncomfortable sense that someone, or something, has been tinkering with my brain, remapping the neural circuitry, reprogramming the memory. My mind isn't going — so far as I can tell — but it's changing. I'm not thinking the way I used to think. I can feel it most strongly when I'm reading. Immersing myself in a book or a lengthy article used to be easy. My mind would get caught up in the narrative or the turns of the argument, and I'd spend hours strolling through long stretches of prose. That's rarely the case anymore. Now my concentration often starts to drift after two or three pages. I get fidgety, lose the thread, begin looking for something else to do. I feel as if I'm always dragging my wayward brain back to the text. The deep reading that used to come naturally has become a struggle.

I think I know what's going on. For more than a decade now, I've been spending a lot of time online, searching and surfing and sometimes adding to the great databases of the Internet. The Web has been a godsend to me as a writer. Research that once required days in the stacks or periodical rooms of libraries can now be done in minutes. A few Google searches, some quick clicks on hyperlinks, and I've got the telltale fact or pithy quote I was after. Even when I'm not working, I'm as likely as not to be foraging in the Web's info-thickets, reading and writing e-mails, scanning headlines and blog posts, watching videos and listening to podcasts, or just tripping from link to link to link. (Unlike footnotes, to which they're sometimes likened, hyperlinks don't merely point to related works; they propel you toward them.)

For me, as for others, the Net is becoming a universal medium, the conduit for most of the information that flows through my eyes and ears and into my mind. The advantages of having immediate access to such an incredibly rich store of information are many, and they've been widely described and duly applauded. "The perfect recall of silicon memory," *Wired*'s Clive Thompson has written, "can be an enormous boon to thinking." But that boon comes at a price. As the media theorist Marshall McLuhan pointed out in the 1960s, media are not just passive channels of information. They supply the stuff of thought, but they also shape the process of thought. And what the Net seems to be doing is chipping away my capacity for concentration and contemplation. My mind now expects to take in information the way the Net distributes it: in a swiftly moving stream of particles. Once I was a scuba diver in the sea of words. Now I zip along the surface like a guy on a Jet Ski.

I'm not the only one. When I mention my troubles with reading to friends and acquaintances — literary types, most of them — many say they're having similar experiences. The more they use the Web, the more they have to fight to stay focused on long pieces of writing. Some of the bloggers I follow have also begun mentioning the phenomenon. Scott Karp, who writes a blog about online media, recently confessed that he has stopped reading books altogether. "I was a lit major in college, and used to be [a] voracious book reader," he wrote. "What happened?" He speculates on the answer: "What if I do all my reading on the web not so much because the way I read has changed, i.e., I'm just seeking convenience, but because the way I THINK has changed?"

Bruce Friedman, who blogs regularly about the use of computers in medicine, also has described how the Internet has altered his mental habits. "I now have almost totally lost the ability to read and absorb a longish article on the web or in print," he wrote earlier this year. A pathologist who has long been on the faculty of the University of Michigan Medical School, Friedman elaborated on his comment in a telephone conversation with me. His thinking, he said, has taken on a "staccato" quality, reflecting the way he quickly scans short passages of text from many sources online. "I can't read *War and Peace* anymore," he admitted. "I've lost the ability to do that. Even a blog post of more than three or four paragraphs is too much to absorb. I skim it."

Anecdotes alone don't prove much. And we still await the long-term neurological and psychological experiments that will provide a definitive picture of how Internet use affects cognition. But a recently published study of online research habits , conducted by scholars from University College London, suggests that we may well be in the midst of a sea change in the way we read and think. As part of the five-year research program, the scholars examined computer logs documenting the behavior of visitors to two popular research sites, one operated by the British Library and one by a U.K. educational consortium, that provide access to journal articles, e-books, and other sources of written information. They found that people using the sites exhibited "a form of skimming activity," hopping from one source to another and rarely returning to any source they'd already visited. They typically read no more than one or two pages of an article or book before they would "bounce" out to another site. Sometimes they'd save a long article, but there's no evidence that they ever went back and actually read it. The authors of the study report:

> It is clear that users are not reading online in the traditional sense; indeed there are signs that new forms of "reading" are emerging as users "power browse" horizontally through titles, contents pages and abstracts going for quick wins. It almost seems that they go online to avoid reading in the traditional sense.

Thanks to the ubiquity of text on the Internet, not to mention the popularity of text-messaging on cell phones, we may well be reading more today than we did in the 1970s or 1980s, when television was our medium of choice. But it's a different kind of reading, and behind it lies a different kind of thinking — perhaps even a new sense of the self. "We are not only *what* we read," says Maryanne Wolf, a developmental psychologist at Tufts University and the author of *Proust and the Squid: The Story and Science of the Reading Brain*. "We are *how* we read." Wolf worries that the style of reading promoted by the Net, a style that puts "efficiency" and "immediacy" above all else, may be weakening our capacity for the kind of deep reading that emerged when an earlier technology, the printing press, made long and complex works of prose commonplace. When we read online, she ys, we tend to become "mere decoders of information." Our ability to interpret xt, to make the rich mental connections that form when we read deeply and ithout distraction, remains largely disengaged.

Reading, explains Wolf, is not an instinctive skill for human beings. It's not ched into our genes the way speech is. We have to teach our minds how to anslate the symbolic characters we see into the language we understand. And ıe media or other technologies we use in learning and practicing the craft of ·ading play an important part in shaping the neural circuits inside our brains. xperiments demonstrate that readers of ideograms, such as the Chinese, develop mental circuitry for reading that is very different from the circuitry found in ıose of us whose written language employs an alphabet. The variations extend :ross many regions of the brain, including those that govern such essential cog-itive functions as memory and the interpretation of visual and auditory stimuli. /e can expect as well that the circuits woven by our use of the Net will be ifferent from those woven by our reading of books and other printed works.

Sometime in 1882, Friedrich Nietzsche bought a typewriter — a Malling-lansen Writing Ball, to be precise. His vision was failing, and keeping his eyes)cused on a page had become exhausting and painful, often bringing on crushing eadaches. He had been forced to curtail his writing, and he feared that he would)on have to give it up. The typewriter rescued him, at least for a time. Once he ad mastered touch-typing, he was able to write with his eyes closed, using only ıe tips of his fingers. Words could once again flow from his mind to the page.

But the machine had a subtler effect on his work. One of Nietzsche's ·iends, a composer, noticed a change in the style of his writing. His already :rse prose had become even tighter, more telegraphic. "Perhaps you will ırough this instrument even take to a new idiom," the friend wrote in a letter, oting that, in his own work, his "'thoughts' in music and language often epend on the quality of pen and paper."

"You are right," Nietzsche replied, "our writing equipment takes part in the)rming of our thoughts." Under the sway of the machine, writes the German ıedia scholar Friedrich A. Kittler, Nietzsche's prose "changed from arguments ɔ aphorisms, from thoughts to puns, from rhetoric to telegram style."

The human brain is almost infinitely malleable. People used to think that our ıental meshwork, the dense connections formed among the 100 billion or so neu-ons inside our skulls, was largely fixed by the time we reached adulthood. But ırain researchers have discovered that that's not the case. James Olds, a professor ıf neuroscience who directs the Krasnow Institute for Advanced Study at George Aason University, says that even the adult mind "is very plastic." Nerve cells rou-inely break old connections and form new ones. "The brain," according to Olds, 'has the ability to reprogram itself on the fly, altering the way it functions."

As we use what the sociologist Daniel Bell has called our "intellectual echnologies" — the tools that extend our mental rather than our physical :apacities — we inevitably begin to take on the qualities of those technologies. [he mechanical clock, which came into common use in the 14th century,)rovides a compelling example. In *Technics and Civilization*, the historian and :ultural critic Lewis Mumford described how the clock "disassociated time from human events and helped create the belief in an independent world of mathematically measurable sequences." The "abstract framework of divided time" became "the point of reference for both action and thought."

The clock's methodical ticking helped bring into being the scientific mind and the scientific man. But it also took something away. As the late MIT computer scientist Joseph Weizenbaum observed in his 1976 book, *Computer Power and Human Reason: From Judgment to Calculation*, the conception of the world that emerged from the widespread use of timekeeping instruments "remains an impoverished version of the older one, for it rests on a rejection of those direct experiences that formed the basis for, and indeed constituted, the old reality." In deciding when to eat, to work, to sleep, to rise, we stopped listening to our senses and started obeying the clock.

The process of adapting to new intellectual technologies is reflected in the changing metaphors we use to explain ourselves to ourselves. When the mechanical clock arrived, people began thinking of their brains as operating "like clockwork." Today, in the age of software, we have come to think of them as operating "like computers." But the changes, neuroscience tells us, go much deeper than metaphor. Thanks to our brain's plasticity, the adaptation occurs also at a biological level.

The Internet promises to have particularly far-reaching effects on cognition. In a paper published in 1936, the British mathematician Alan Turing proved that a digital computer, which at the time existed only as a theoretical machine, could be programmed to perform the function of any other information-processing device. And that's what we're seeing today. The Internet, an immeasurably powerful computing system, is subsuming most of our other intellectual technologies. It's becoming our map and our clock, our printing press and our typewriter, our calculator and our telephone, and our radio and TV.

When the Net absorbs a medium, that medium is re-created in the Net's image. It injects the medium's content with hyperlinks, blinking ads, and other digital gewgaws, and it surrounds the content with the content of all the other media it has absorbed. A new e-mail message, for instance, may announce its arrival as we're glancing over the latest headlines at a newspaper's site. The result is to scatter our attention and diffuse our concentration.

The Net's influence doesn't end at the edges of a computer screen, either. As people's minds become attuned to the crazy quilt of Internet media, traditional media have to adapt to the audience's new expectations. Television programs add text crawls and pop-up ads, and magazines and newspapers shorten their articles, introduce capsule summaries, and crowd their pages with easy-to-browse info-snippets. When, in March of this year, the *New York Times* decided to devote the second and third pages of every edition to article abstracts, its design director, Tom Bodkin, explained that the "shortcuts" would give harried readers a quick "taste" of the day's news, sparing them the "less efficient" method of actually turning the pages and reading the articles. Old media have little choice but to play by the new-media rules.

Never has a communications system played so many roles in our lives — or exerted such broad influence over our thoughts — as the Internet does today. Yet, for all that's been written about the Net, there's been little consideration of how, exactly, it's reprogramming us. The Net's intellectual ethic remains obscure.

About the same time that Nietzsche started using his typewriter, an earnest young man named Frederick Winslow Taylor carried a stopwatch into the Midvale Steel plant in Philadelphia and began a historic series of experiments aimed at improving the efficiency of the plant's machinists. With the approval of Midvale's owners, he recruited a group of factory hands, set them to work on various metal-working machines, and recorded and timed their every movement as well as the operations of the machines. By breaking down every job into a sequence of small, discrete steps and then testing different ways of performing each one, Taylor created a set of precise instructions — an "algorithm," we might say today — for how each worker should work. Midvale's employees grumbled about the strict new regime, claiming that it turned them into little more than automatons, but the factory's productivity soared.

More than a hundred years after the invention of the steam engine, the Industrial Revolution had at last found its philosophy and its philosopher. Taylor's tight industrial choreography — his "system," as he liked to call it — was embraced by manufacturers throughout the country and, in time, around the world. Seeking maximum speed, maximum efficiency, and maximum output, factory owners used time-and-motion studies to organize their work and configure the jobs of their workers. The goal, as Taylor defined it in his celebrated 1911 treatise, *The Principles of Scientific Management*, was to identify and adopt, for every job, the "one best method" of work and thereby to effect "the gradual substitution of science for rule of thumb throughout the mechanic arts." Once his system was applied to all acts of manual labor, Taylor assured his followers, it would bring about a restructuring not only of industry but of society, creating a utopia of perfect efficiency. "In the past the man has been first," he declared; "in the future the system must be first."

Taylor's system is still very much with us; it remains the ethic of industrial manufacturing. And now, thanks to the growing power that computer engineers and software coders wield over our intellectual lives, Taylor's ethic is beginning to govern the realm of the mind as well. The Internet is a machine designed for the efficient and automated collection, transmission, and manipulation of information, and its legions of programmers are intent on finding the "one best method" — the perfect algorithm — to carry out every mental movement of what we've come to describe as "knowledge work."

Google's headquarters, in Mountain View, California — the Googleplex — is the Internet's high church, and the religion practiced inside its walls is Taylorism. Google, says its chief executive, Eric Schmidt, is "a company that's founded around the science of measurement," and it is striving to "systematize everything" it does. Drawing on the terabytes of behavioral data it collects through its search engine and other sites, it carries out thousands of experiments a day, according to the *Harvard Business Review*, and it uses the results to refine the algorithms that increasingly control how people find information and extract meaning from it. What Taylor did for the work of the hand, Google is doing for the work of the mind.

The company has declared that its mission is "to organize the world's information and make it universally accessible and useful." It seeks to develop "the perfect search engine," which it defines as something that "understands exactly what you mean and gives you back exactly what you want." In Google's view, information is a kind of commodity, a utilitarian resource that can be mined and processed with industrial efficiency. The more pieces of information we can "access" and the faster we can extract their gist, the more productive we become as thinkers.

Where does it end? Sergey Brin and Larry Page, the gifted young men who founded Google while pursuing doctoral degrees in computer science at Stanford, speak frequently of their desire to turn their search engine into an artificial intelligence, a HAL-like machine that might be connected directly to our brains. "The ultimate search engine is something as smart as people — or smarter," Page said in a speech a few years back. "For us, working on search is a way to work on artificial intelligence." In a 2004 interview with *Newsweek*, Brin said, "Certainly if you had all the world's information directly attached to your brain, or an artificial brain that was smarter than your brain, you'd be better off." Last year, Page told a convention of scientists that Google is "really trying to build artificial intelligence and to do it on a large scale."

Such an ambition is a natural one, even an admirable one, for a pair of math whizzes with vast quantities of cash at their disposal and a small army of computer scientists in their employ. A fundamentally scientific enterprise, Google is motivated by a desire to use technology, in Eric Schmidt's words, "to solve problems that have never been solved before," and artificial intelligence is the hardest problem out there. Why wouldn't Brin and Page want to be the ones to crack it?

Still, their easy assumption that we'd all "be better off" if our brains were supplemented, or even replaced, by an artificial intelligence is unsettling. It suggests a belief that intelligence is the output of a mechanical process, a series of discrete steps that can be isolated, measured, and optimized. In Google's world, the world we enter when we go online, there's little place for the fuzziness of contemplation. Ambiguity is not an opening for insight but a bug to be fixed. The human brain is just an outdated computer that needs a faster processor and a bigger hard drive.

The idea that our minds should operate as high-speed data-processing machines is not only built into the workings of the Internet, it is the network's reigning business model as well. The faster we surf across the Web — the more links we click and pages we view — the more opportunities Google and other companies gain to collect information about us and to feed us advertisements. Most of the proprietors of the commercial Internet have a financial stake in collecting the crumbs of data we leave behind as we flit from link to link — the more crumbs, the better. The last thing these companies want is to encourage leisurely reading or slow, concentrated thought. It's in their economic interest to drive us to distraction.

Maybe I'm just a worrywart. Just as there's a tendency to glorify technological progress, there's a countertendency to expect the worst of every new tool or machine. In Plato's *Phaedrus*, Socrates bemoaned the development of writing.

le feared that, as people came to rely on the written word as a substitute for the nowledge they used to carry inside their heads, they would, in the words of ne of the dialogue's characters, "cease to exercise their memory and become orgetful." And because they would be able to "receive a quantity of information rithout proper instruction," they would "be thought very knowledgeable when ney are for the most part quite ignorant." They would be "filled with the coneit of wisdom instead of real wisdom." Socrates wasn't wrong — the new techology did often have the effects he feared — but he was shortsighted. He ouldn't foresee the many ways that writing and reading would serve to spread nformation, spur fresh ideas, and expand human knowledge (if not wisdom).

The arrival of Gutenberg's printing press, in the 15th century, set off another ound of teeth gnashing. The Italian humanist Hieronimo Squarciafico worried hat the easy availability of books would lead to intellectual laziness, making men less studious" and weakening their minds. Others argued that cheaply printed ooks and broadsheets would undermine religious authority, demean the work f scholars and scribes, and spread sedition and debauchery. As New York Jniversity professor Clay Shirky notes, "Most of the arguments made against the rinting press were correct, even prescient." But, again, the doomsayers were nable to imagine the myriad blessings that the printed word would deliver.

So, yes, you should be skeptical of my skepticism. Perhaps those who dismiss ritics of the Internet as Luddites or nostalgists will be proved correct, and from ur hyperactive, data-stoked minds will spring a golden age of intellectual discovery and universal wisdom. Then again, the Net isn't the alphabet, and lthough it may replace the printing press, it produces something altogether different. The kind of deep reading that a sequence of printed pages promotes is aluable not just for the knowledge we acquire from the author's words but for he intellectual vibrations those words set off within our own minds. In the quiet paces opened up by the sustained, undistracted reading of a book, or by any ther act of contemplation, for that matter, we make our own associations, draw our own inferences and analogies, foster our own ideas. Deep reading, as Maryanne Wolf argues, is indistinguishable from deep thinking.

If we lose those quiet spaces, or fill them up with "content," we will sacrifice omething important not only in our selves but in our culture. In a recent essay, he playwright Richard Foreman eloquently described what's at stake:

I come from a tradition of Western culture, in which the ideal (my ideal) was the complex, dense and "cathedral-like" structure of the highly educated nd articulate personality — a man or woman who carried inside themselves a personally constructed and unique version of the entire heritage of the West. [But now] I see within us all (myself included) the replacement of complex inner density with a new kind of self — evolving under the pressure of information overload and the technology of the "instantly available."

As we are drained of our "inner repertory of dense cultural inheritance," Foreman concluded, we risk turning into "'pancake people' — spread wide and thin as we connect with that vast network of information accessed by the mere touch of a button."

I'm haunted by that scene in *2001*. What makes it so poignant, and so weird, is the computer's emotional response to the disassembly of its mind: its despair as one circuit after another goes dark, its childlike pleading with the astronaut — "I can feel it. I can feel it. I'm afraid" — and its final reversion to what can only be called a state of innocence. HAL's outpouring of feeling contrasts with the emotionlessness that characterizes the human figures in the film, who go about their business with an almost robotic efficiency. Their thoughts and actions feel scripted, as if they're following the steps of an algorithm. In the world of *2001*, people have become so machinelike that the most human character turns out to be a machine. That's the essence of Kubrick's dark prophecy: as we come to rely on computers to mediate our understanding of the world, it is our own intelligence that flattens into artificial intelligence.

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Net Neutrality 101

SAVE THE INTERNET

Savetheinternet.com is an activism and lobbying campaign that describes itself as "a coalition of two million everyday people who have banded together with thousands of nonprofit organizations, businesses and bloggers to protect Internet freedom. http://savetheinternet.com/faq" It is coordinated by a nonprofit group called "Free Press" devoted to reforming the media. Among those listed as members of the coalition are activist Professor Lawrence Lessig, Craig Newmark (founder of craigslist.org), and the American Civil Liberties Union. This short article, taken from Save the Internet's web site, presents the organization's case for net neutrality, the principle that Internet service providers may not discriminate among different forms of content and applications by charging them different rates or by prioritizing their transmission based on their political or economic substance, or the producers' willingness or ability to pay for preferential treatment. More information can be found on the coalition's web site. For a two-minute animated cartoon version of this article see http://www.youtube.com/watch?v=L11kLmWha6o.

When we log onto the Internet, we take lots of things for granted. We assume that we'll be able to access whatever Web site we want, whenever we want to go there. We assume that we can use any feature we like — watching online video, listening to podcasts, searching, e-mailing and instant messaging — anytime we choose. We assume that we can attach devices like wireless routers, game controllers or extra hard drives to make our online experience better.

What makes all these assumptions possible is "Network Neutrality," the guiding principle that preserves the free and open Internet. Net Neutrality means that Internet service providers may not discriminate between different kinds of content and applications online. It guarantees a level playing field for all Web sites and Internet technologies. But all that could change.

Save the Internet, "Net Neutrality 101," http://www.savetheinternet.com/net-neutrality-101. Reprinted by permission.

The biggest cable and telephone companies would like to charge money for smooth access to Web sites, speed to run applications, and permission to plug in devices. These network giants believe they should be able to charge Web site operators, application providers and device manufacturers for the right to use the network. Those who don't make a deal and pay up will experience discrimination: Their sites won't load as quickly, and their applications and devices won't work as well. Without legal protection, consumers could find that a network operator has blocked the Web site of a competitor, or slowed it down so much that it's unusable.

The network owners say they want a "tiered" Internet. If you pay to get in the top tier, your site and your service will run fast. If you don't, you'll be in the slow lane.

What's the Problem Here?

Discrimination: The Internet was designed as an open medium. The fundamental idea since the Internet's inception has been that every Web site, every feature and every service should be treated without discrimination. That's how bloggers can compete with CNN or *USA Today* for readers. That's how up-and-coming musicians can build underground audiences before they get their first top-40 single. That's why when you use a search engine, you see a list of the sites that are the closest match to your request — not those that paid the most to reach you. Discrimination endangers our basic Internet freedoms.

Double-dipping: Traditionally, network owners have built a business model by charging consumers for Internet access. Now they want to charge you for access to the network, and then charge you again for the things you do while you're online. They may not charge you directly via pay-per-view Web sites. But they will charge all the service providers you use. These providers will then pass those costs along to you in the form of price hikes or new charges to view content.

Stifling innovation: Net Neutrality ensures that innovators can start small and dream big about being the next eBay or Google without facing insurmountable hurdles. Unless we preserve Net Neutrality, startups and entrepreneurs will be muscled out of the marketplace by big corporations that pay for a top spot on the Web. On a tiered Internet controlled by the phone and cable companies, only their own content and services — or those offered by corporate partners that pony up enough "protection money" — will enjoy life in the fast lane.

The End of the Internet?

Make no mistake: The free-flowing Internet as we know it could very well become history. What does that mean? It means we could be headed toward a pay-per-view Internet where Web sites have fees. It means we may have to pay a network tax to run voice-over-the-Internet phones, use an advanced search engine, or chat via Instant Messenger. The next generation of inventions will be shut out of the top-tier service level. Meanwhile, the network owners will rake in even greater profits.

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Managing Broadband Networks

GEORGE OU

A somewhat more dispassionate and technically detailed look at the issue of net neutrality is contained in a report titled "Managing Broadband Networks: A Policymaker's Guide," of which the following article is the executive summary. The report was prepared under the auspices of the Information Technology and Innovation Foundation (ITIF), a non-partisan Washington-based think tank founded in 2006 and devoted to public policy issues related to innovation, productivity, and the digital economy. The report contends that the fears of those who advocate net neutrality result from a "lack of understanding of the history of the Internet, the economics of the ISP industry, and the science of network engineering." Aimed at helping policy-makers understand these issues and develop a more balanced approach to network management, the article describes the basic elements of broadband networks and some of the misconceptions about their operations. It concludes with a number of recommendations for policymakers, essentially suggesting that legislating net neutrality is undesirable and likely to be counterproductive.

The author of the report, George Ou, is a senior analyst at ITIF, working out of Silicon Valley. He has served as Technical Director and Editor at Large for TechRepublic and ZDNet. A technical journalist with a background in information technology, Ou is the founder of the web site, ForMortals.com, whose banner reads, "Technology for Mortals: Because technology isn't just for geeks."

The Internet has changed the face of communications, commerce, and indeed the world. And over time the Internet itself has changed too. Until recently, most Americans at home accessed the Internet using telephone dial-up connections

George Ou, *Managing Broadband Networks: A Policymaker's Guide* (Washington, DC: The Information Technology and Innovation Foundation), executive summary, pp. 1–5. Reprinted by permission.

rather than today's faster broadband connections. With slower connections, home users limited themselves to a few basic online activities, such as email and web browsing, which perform passably well even on a slow network. In this environment, the need for Internet service providers (ISPs) to manage their networks to ensure the best possible experience for their customers was limited.

Today most Americans connect to the Internet over broadband connections that are in some cases 400 times faster than the dial-up connections of the late 1990s. But it is precisely because of these new bigger "pipes" that ISPs are finding that they need to more actively manage their networks. Broadband networks have enabled the rise of new applications, including those that need to be managed if they are to work effectively (e.g., voice over Internet Protocol, online gaming, video conferencing, and Internet Protocol–based TV) and those that can cause other applications to fail on an unmanaged network (e.g., many peer-to-peer (P2P) applications).

With this exciting transformation of the Internet into the universal communication platform of the future, network engineers face an array of daunting challenges. Specifically, to provide customers a good Internet service and operate their networks efficiently, ISPs must be able to do two very important things: 1) allocate limited bandwidth fairly among users; and, 2) apply network management tools to shape traffic from multiple applications. ISPs can and should do these things in a fair and nondiscriminatory manner. Thus, they should strive to ensure that customers who pay for the same tier of service get roughly the same bandwidth at a given level of usage, eliminate harmful variations of delay (i.e., jitter), make consumers' broadband service more conducive to using multiple applications simultaneously, while at the same time treating other applications and content fairly.

Unfortunately, network management solutions have come under heavy criticism from many advocates of "net neutrality." The issue of network management came to the fore when Comcast limited the ability of peer-to-peer (P2P) users to operate in upload-only mode whenever P2P traffic exceeded 50 percent of total upstream capacity of the entire neighborhood. More generally, the issue of network management refers to whether and to what extent ISPs can manage their networks to ensure quality of service for the majority of their customers.

Strong advocates of net neutrality argue that ISPs should have little flexibility to manage their networks and that the solution to any kinds of network congestion or other network performance challenges can and should be solved by simply adding more network capacity — primarily in the form of "bigger pipes." Indeed, they fear that using efficient network management techniques may enable network operators to abuse their power, thereby stifling free speech and civic expression and erecting unfair barriers to other companies seeking to distribute digital content or applications. Moreover, some proponents of net neutrality fear that any improvement in the efficiency of the Internet will eliminate the motivation of ISPs to expand network capacity by "building bigger pipes." As we transition to a ubiquitous digital world, bigger pipes are necessary — and public policy should support their deployment — but they are not a substitute for network management. We need to not just expand network capacity, but also build networks that are better and more intelligently managed.

Many if not most of the fears of the proponents of net neutrality stem from a lack of understanding of the history of the Internet, the economics of the ISP industry, and the science of network engineering. This guide is intended to help policymakers better understand how broadband networks and the applications that run on them work, and calls for a balanced approach to the regulation of broadband network management. A balanced approach should be based on reality: both the economic realities of building broadband networks and the scientific realities of network engineering. In addition, it should provide ISPs the flexibility they need to manage complex networks while also ensuring oversight to ensure that network management practices are not being applied in anti-competitive ways.

Effective policy in this area must be based on facts. Unfortunately much of the debate over broadband network management to date has been informed more by rhetoric and emotion than by an actual examination of how advanced networks and the applications that run on them work. By providing policymakers with this guide, ITIF hopes to better inform this debate.

KEY FINDINGS AND CONCLUSIONS

- **Packet-switched networks, like the Internet, have advantages, but also disadvantages.** Packet-switched networks like the Internet were invented for their flexibility and efficiency, characteristics which are optimum for data applications. But they have two key deficiencies in the absence of network management: 1) inability to equitably allocate bandwidth; and 2) high jitter, which are essentially micro-congestion storms that last tens or hundreds of milliseconds, and which can disrupt real-time applications such as VoIP, online gaming, video conferencing, and IPTV.
- **The Internet and its predecessor ARPANET became the first adopter of packet-switching networks because it was more efficient and flexible than the circuit-switching telephone network.** Unlike telephone networks which only connected a small percentage of users at any given time, packet-switched networks allow everyone to be on the network at the same time and dynamically divide up the resources among the active users. If few users are on the network, then those users get a lot of resources allocated to them. If many users are on the network, then each user gets fewer resources but no user is locked out. This dynamic expansion and contraction of bandwidth makes packet switching networks very efficient, but the allocation of bandwidth can become disproportionate whenever applications like P2P resist reallocations of bandwidth. Network management can balance the allocation of bandwidth such that each customer in the same service tier gets an equitable share of the total bandwidth.

- **Network management techniques, such as quality of service (QoS) mechanisms, make a packet-switched network more conducive to simultaneous application usage.** Network management techniques such as QoS essentially carve out virtual circuits within a packet-switched network by providing the necessary resources and performance characteristics that real-time applications need. This gives a packet-switched network the real-time characteristics of a circuit-switched network while maintaining the robustness and flexibility of a packet-switched network.
- **Even since its early days, the Internet has been a managed network.** The Internet has had basic network management mechanisms built into it since its inception, although these mechanisms have undergone and continue to undergo much refinement as usage patterns on the Internet change. Since 1987, for example, computers have used a revised version of the transmission control protocol (TCP) that includes a network congestion control mechanism developed by computer scientist Van Jacobson to slow down endpoints and prevent network meltdown.
- **Peer-to-peer (P2P) applications pose special challenges to broadband networks.** P2P users on unmanaged networks can use a disproportionately high amount of bandwidth and cause network congestion. In Japan, for example, P2P users represent 10 percent of the total broadband population but account for 65 to 90 percent of traffic on the network. By running multiple TCP flows (i.e., connections) per file transfer, P2P applications can effectively circumvent the Jacobson algorithm intended to allocate bandwidth. As a result, P2P applications can maximize the use of available bandwidth, sometimes at the expense of other applications, such as VoIP and video conferencing, which require low latency and jitter.
- **An ISP that dynamically allocates its network capacity can always offer its customers far more unguaranteed bandwidth than its guaranteed minimum level of service.** Because broadband networks are shared, it is more efficient to give consumers access to speeds that can increase when there is less congestion. Since only 1 to 10 percent of network users are active at any point in time, packet switching networks can dynamically allocate 10 to 100 times more bandwidth to each active user. If a network can be built to guarantee 1 megabit per second (Mbps) of performance for each user, for example, it can just as easily offer the customer 1 Mbps of guaranteed performance and up to 20 Mbps of unguaranteed performance. But building a network that provided a guaranteed performance of 20 Mbps, for example, would be much more expensive and require much higher monthly costs for the consumer.
- **One goal of network management is to fairly allocate bandwidth between paying customers.** Fairness dictates that customers who are paying for the same tier of broadband service from a broadband provider should get roughly the same bandwidth at a given level of usage. Fair bandwidth allocation shouldn't just measure instantaneous bandwidth

usage, duration should also be factored in to the equitable distribution of bandwidth. If one application or one customer uses the network hundreds or thousands of times more frequently than another application or customer, it isn't unreasonable to let the short duration application or customer get a short boost in bandwidth over the long duration application or customer.

To achieve fair bandwidth allocations, protocol-agnostic schemes are the best solution. ISPs can use protocol-agnostic network management systems (systems that measure the aggregate bandwidth consumption of each customer and not what protocols they are using) to ensure that bandwidth is shared fairly between customers. Early network management systems that used less accurate protocol-specific schemes to allocate bandwidth between customers worked well most of the time but experienced occasional problems. These protocol agnostic solutions are being evaluated by broadband providers. A key downside of protocol-agnostic network management systems is that they are often too expensive for smaller ISPs to deploy.

- **Another goal of network management is to better share network resources between many different applications.** Different types of applications have different network requirements. Real-time applications (e.g., VoIP) are most sensitive to network jitter. Video streaming applications (e.g., YouTube) have moderate fixed bandwidth requirements and moderate jitter tolerance. Interactive applications (e.g., web browsing) have brief bursts in bandwidth that could disrupt real-time or streaming applications. Background applications (e.g., P2P applications) are designed to be unattended with no one waiting for an instant response.
- **Packets should be ordered logically with priority given to real-time applications first, streaming applications second, interactive applications third, and background applications last.** In order for all applications efficiently and fairly share an Internet connection, those with higher duration and higher bandwidth consumption (e.g., P2P) are given lower priority than applications with lower duration and lower bandwidth consumption (e.g., VoIP applications). This does not mean P2P applications are being mistreated because they still receive the highest average bandwidth from the network.
- **To better enable multiple applications to share an Internet connection, protocol-specific schemes are necessary.** Application protocols that require low packet delay must be identified and must be protected against high variations in packet delay (e.g., jitter) and Quality of Service network management techniques are the mechanism that provides that protection.
- **Wireless networks require more management than wired networks.** Wireless networks require more network management than wired networks because they have less bandwidth available and it must be shared more

frequently. Furthermore, multiple radio transmitters sharing the same wireless frequency in the same geographic location results in a high probability of radio interference which can bring networks to a halt. These unique challenges of wireless networks require the most elaborate network management system of all in the form of a centralized scheduler which coordinates the transmission slots for network users as tightly and efficiently as possible without collision.

- **Wireless network management enables innovation.** Intelligent wireless networks will ultimately spur more adoption and usage of wireless broadband, which facilitates more mobile e-commerce and enables more innovation and generation of wealth.

RESPONDING TO COMMON MISPERCEPTIONS ABOUT NETWORK MANAGEMENT

- **Network management techniques, such as QoS, do not put low priority applications on a "dirt road."** QoS gives higher prioritization to applications that have lower bandwidth, lower duration, and higher sensitivity to packet delay. In spite of this, applications that are given the least priority still end up receiving the highest average bandwidth from the network. But with this logical prioritization scheme in place, low priority applications like P2P applications interfere less with other applications sharing the same network. This in turn allows P2P applications to operate freely without any artificial constraints on when to use them or how much bandwidth to allocate to them which are commonly used on unmanaged networks.
- **Building more bandwidth, while desirable, does not eliminate the need for network management.** Advancing the digital economy requires higher speed broadband. However, higher speed networks will not preclude the need for network management. First, as network capacity grows, network demand also grows, as new kinds of applications emerge to take advantage of the capacity. Second, networks with plenty of spare unused capacity on average can still suffer instantaneous shortages at peak times of the day. Third, networks operating at low utilization levels can still suffer packet delay in the form of jitter.
- **Metered pricing and usage caps alone will not solve the problem of network congestion.** Metered pricing and bandwidth usage caps are legitimate tools for ensuring the efficient use of networks, but they cannot control instantaneous bursts in demand nor can they deal with the problem of jitter and the inability of dumb networks to gracefully support multiple applications. Only advanced network management techniques like quality of service can deal with these challenges.

POLICY IMPLICATIONS

- **Legislation and regulations should not limit efforts by ISPs to fairly use network management to overcome technical challenges and maintain a high quality Internet service for their customers.** As described in this report, ISPs face many technical challenges to manage network congestion and support various online applications. Network management is a necessary and important component of broadband networks, and policymakers should support its use. However, this freedom to manage the network is not a license for ISPs to behave in anti-competitive ways such as blocking legitimate websites or unreasonably degrading services that users have paid to access. Neither should ISPs unreasonably discriminate against any content or service on the open Internet.
- **Policymakers should be cognizant of the effects of certain proposed legislation on the use of network management.** Some proposed net neutrality bills ban differentiated pricing for enhanced QoS and would have undesirable and unintended consequences. One intent of these bills is to facilitate more open Internet bandwidth for broadband consumers, but the result may be just the opposite. Not allowing network operators to prioritize their own IPTV content above other Internet content, for example, will simply push those cable TV-like services onto private circuits that share the same physical network. That would result in less Internet bandwidth being available on a permanent basis for broadband consumers even when they are not using their IPTV service.
- **The federal government has a key role to ensure openness and fair play on the Internet.** However, it should do this with sensible rules. Policies should strive to prevent any potential abuse without eliminating the ability of ISPs to manage their networks in ways that produce the best possible user experience for the largest number of users, and without eliminating incentives to build the next generation broadband network. Toward that end the FCC should oversee broadband providers and ensure that their ISP network management practices are open, transparent and not harmful to competition. And the ISP industry should continue its efforts to develop and abide by industry codes of good conduct regarding network management that include, but are not limited to, fuller and more transparent disclosure to consumers of network management practices.

CONCLUSION

The Internet in all its glory has never had a perfect architecture. There have always been conflicts between users and applications competing for scarce network resources. Network management is necessary to fairly allocate bandwidth between customers and seamlessly support multiple applications on shared network connections.

The Internet and broadband technology are continuing to evolve at a fairly rapid rate, and neither shows any signs of maturing. Network engineers continue to find new solutions to improve the Internet experience for all users. This situation makes it very difficult, if not impossible, to predict where the market and technology will evolve. The Internet is so valuable precisely because it is open to anyone, for any use, and for any business model, but participation has always required varying levels of payment for varying levels of service between willing parties. Given this environment, it is best for policymakers not to issue blanket prohibitions on network management technology and existing business models. Instead, policies should focus on creating better transparency for all Internet companies along with FCC oversight to ensure that broadband providers are managing networks in ways that are not unfair or anticompetitive.