The Internet of Things and Wearable Technology

Addressing Privacy and Security Concerns without Derailing Innovation

Adam Thierer

November 2014

MERCATUS WORKING PAPER

MERCATUS CENTER
George Mason University

3434 Washington Blvd., 4th Floor, Arlington, Virginia 22201
www.mercatus.org

Adam Thierer. "The Internet of Things and Wearable Technology: Addressing Privacy and Security Concerns without Derailing Innovation." Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, November 2015. http://mercatus.org/publication/internet-things-and-wearable-technology-addressing-privacy-and-security-concerns-without.

Abstract

This paper highlights some of the opportunities presented by the rise of the so-called Internet of Things in general and wearable technology in particular and encourages policymakers to allow these technologies to develop in a relatively unabated fashion. As with other new and highly disruptive digital technologies, however, the Internet of Things and wearable technology will challenge existing social, economic, and legal norms. In particular, these technologies raise a variety of privacy and safety concerns. The better alternative to top-down regulation is to deal with those concerns creatively as they develop, using a combination of educational efforts, technological empowerment tools, social norms, public and watchdog pressure, industry best practices and self-regulation, transparency, and targeted enforcement of existing legal standards (especially torts), as needed. This bottom-up and layered approach to dealing with problems will not preemptively suffocate technological experimentation and innovation. This paper concludes by outlining those solutions. Finally, policymakers should not forget that societal and individual adaptation will play a role here, just as it has during so many other turbulent technological transformations.

JEL codes: L86, L88, L5, K13, K00, K39, O3, O31, O33, M38

Keywords: Internet of things, wearable technology, online privacy, online safety, online security, Federal Trade Commission, FTC, permissionless innovation, precautionary principle, technopanic, free speech, biohacking

Author Affiliation and Contact Information

Adam Thierer
Senior Research Fellow
Mercatus Center at George Mason University
athierer@mercatus.gmu.edu

Note: Portions of this paper have been adapted from Adam Thierer, *Permissionless Innovation: The Continuing Case for Comprehensive Technological Freedom* (2014). The author thanks the following individuals for their helpful comments on various drafts of this paper: Robert Graboyes, Jerry Brito, Dan Caprio, Ryan Hagemann, Will Rinehart, Ryan Radia, and two anonymous reviewers.

The Internet of Things and Wearable Technology:

Addressing Privacy and Security Concerns without Derailing Innovation

Adam Thierer

Contents

I. Introduction

The next great wave of Internet-enabled innovation has arrived, and it is poised to revolutionize the way humans interact with the world around them. This paper highlights some of the opportunities presented by the rise of the so-called Internet of Things (IoT) in general and wearable technology in particular and encourages policymakers to allow these technologies to develop in a relatively unabated fashion.

Wearable technologies are networked devices that can collect data, track activities, and customize experiences to users' needs and desires. These technologies are a subset of IoT, which comprises networked "smart devices" equipped with microchips, sensors, and wireless communications capabilities.[1] Wearable technologies are among the fastest-growing segment of IoT and promise to have widespread societal influences in the coming years.[2]

As with other new and highly disruptive digital technologies, however, IoT and wearable technology will challenge existing social, economic, and legal norms. In particular, these technologies raise a variety of privacy and safety concerns. Other barriers exist that could hinder IoT and wearable technology—including disputes over technical standards, system interoperability, and access to adequate wireless spectrum to facilitate ubiquitous networking capabilities—but those issues will not be discussed in this paper.[3] Some wearable technologies will raise safety concerns, but those issues will be only briefly addressed. The focus of this

---

[1] Charles McLellan, *M2M and the Internet of Things: A Guide*, ZDNET (Jan. 10, 2013), http://www.zdnet.com/m2m-and-the-internet-of-things-7000008219.

[2] David Evans, *The Future of Wearable Technology: Smaller, Cheaper, Faster, and Truly Personal Computing*, LINKEDIN (Oct. 24, 2013), http://www.linkedin.com/today/post/article/20131024145405-122323-the-future-of-wearable-technology-smaller-cheaper-faster-and-truly-personal-computing.

[3] Bob Violino, *The Internet of Things Gets Real*, NETWORK WORLD (June 2, 2014), http://www.networkworld.com/news/2014/060214-internet-of-things-281935.html?hpg1=bn (quoting Daniel Castro, Director of the Information Technology and Innovation Foundation's Center for Data Innovation in Washington, saying that "[a] big issue is standards and interoperability" and that "[b]uilding the IoT will require massive amounts of cooperation and coordination between firms").

paper will be on the privacy and security concerns that are already prompting calls for policy interventions.[4]

Some of the privacy and security concerns about IoT and wearable technologies are legitimate and deserve responses. But those responses should not be top down or command and control in nature. Privacy and security are important values worthy of attention, but so too are innovation, entrepreneurialism, economic growth, price competition, and consumer choice. Regulation—especially regulation of fast-moving, rapidly evolving technologies—is likely to be premature and overly rigid and is unlikely to allow the many beneficial uses of these technologies.[5] Such constraints would be highly unfortunate because these technologies "will have profound implications for addressing important social and economic issues."[6]

Therefore, generally speaking and barring clear evidence of direct risk to health or property—not merely hypothetical or ephemeral fears—policymakers should not impose prophylactic restrictions on the use of new wearable technologies and IoT. The default position toward these technologies should be "innovation allowed" or "permissionless innovation."[7] The burden of proof rests on those who favor precautionary regulation; they must explain why ongoing experimentation with IoT technologies should be prevented preemptively by force of law.

---

[4] Scott R. Peppet, *Regulating the Internet of Things: First Steps Toward Managing Discrimination, Privacy, Security, and Consent*, TEX. L. REV. (forthcoming 2014), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2409074.

[5] Daniel F. Spulber, *Unlocking Technology: Antitrust and Innovation*, 4 J. COMPETITION L. & ECON. 915, 965 (2008). ("Governments are notoriously inept at picking technology winners. Understanding technology requires extensive scientific and technical knowledge. Government agencies cannot expect to replicate or improve upon private sector knowledge. Technological innovation is uncertain by its very nature because it is based on scientific discoveries. The benefits of new technologies and the returns to commercial development also are uncertain.")

[6] Daniel Castro, *Internet of Things Meets Holiday Wish Lists*, INFORMATIONWEEK (Dec. 4, 2013), http://www.informationweek.com/strategic-cio/executive-insights-and-innovation/internet-of-things-meets-holiday-wish-lists/d/d-id/1112901.

[7] ADAM THIERER, PERMISSIONLESS INNOVATION: THE CONTINUING CASE FOR COMPREHENSIVE TECHNOLOGICAL FREEDOM ix (2014).

The better alternative to top-down regulation is to deal with concerns creatively as they develop, using a combination of educational efforts, technological empowerment tools, social norms, public and watchdog pressure, industry best practices and self-regulation, transparency, and targeted enforcement of existing legal standards (especially torts), as needed. This bottom-up and layered approach to dealing with problems will not preemptively suffocate technological experimentation and innovation in these spaces. This paper will conclude by outlining those solutions.

Finally, and perhaps most importantly, societal and individual adaptation will play a role here, just as it has during so many other turbulent technological transformations. Although formidable privacy and security challenges are ahead, individuals and institutions will adjust in an evolutionary, resilient fashion, just as they adjusted to earlier disruptive technologies.

II. The Growth of the Internet of Things and Wearable Technology: Applications and Opportunities

A. The Internet of Things Arrives

Many of the underlying drivers of the Internet and Information Age revolution—massive increases in processing power,[8] exploding storage capacity,[9] steady miniaturization of computing and cameras,[10] ubiquitous wireless communications and networking capabilities,[11]

---

[8] HAL ABELSON, KEN LEDEEN & HARRY LEWIS, BLOWN TO BITS: YOUR LIFE, LIBERTY, AND HAPPINESS AFTER THE DIGITAL EXPLOSION 8–9 (2008) ("The rapid increase in processing power means that inventions move out of labs and into consumer goods very quickly.").

[9] Sebastian Anthony, *How Big Is the Cloud?*, EXTREME TECH (May 23, 2012), http://www.extremetech.com /computing/129183-how-big-is-the-cloud; Steve Lohr, *Data Explosion Lifts the Storage Market*, N.Y. TIMES BITS (Sept. 9, 2011), http://bits.blogs.nytimes.com/2011/09/09/data-explosion-lifts-the-storage-market.

[10] Patrick Thibodeau, *Lens-less Camera, Costing Pennies, Brings Vision to the Internet of Things*, COMPUTERWORLD (Sept. 18, 2014), http://www.computerworld.com/article/2685246/lens-less-camera-costing-pennies-brings-vision -to-the-internet-of-things.html; David G. Stork & Patrick R. Gill, *Lensless Ultra-miniature CMOS Computational*

digitization of all data,[12] massive datasets (or "big data"[13])—are beginning to have a profound influence beyond the confines of cyberspace.[14] For example, it is cheaper than ever to integrate a microchip, a sensor, a camera, and even an accelerometer into devices today.[15] "Thanks to advances in circuits and software," observe Neil Gershenfeld and J. P. Vasseur, "it is now possible to make a Web server that fits on (or in) a fingertip for $1."[16] As costs continue to fall[17] and these technologies are increasingly embedded into almost all devices that consumers own and come into contact with, a truly "seamless web" of connectivity and "pervasive computing" will exist.[18]

As a result of these factors, mundane appliances and other machines and devices that consumers have long taken for granted—cars, refrigerators, cooking devices, lights, weight scales, watches, jewelry, eyeglasses, and even their clothing—all will soon be networked, sensing,

---

Imagers and Sensors, RAMBUS.COM, undated manuscript, http://www.rambus.com/assets/documents/papers/StorkGillSensorComm.pdf (last visited Oct. 29, 2014).

[11] Darrell M. West, *The State of the Mobile Economy, 2014: Its Impact and Future*, CENTER FOR TECHNOLOGY INNOVATION RESEARCH PAPER (Brookings Institution), Sept. 10, 2014, *available at* http://www.brookings.edu/research/papers/2014/09/10-state-mobile-economy-2014-west; CHRISTOPHER S. YOO, THE DYNAMIC INTERNET: HOW TECHNOLOGY, USERS, AND BUSINESS ARE TRANSFORMING THE NETWORK 48–54 (2012).

[12] NICHOLAS NEGROPONTE, BEING DIGITAL 14–20 (1995); Abelson et al., *supra* note 8, at 5–6.

[13] Letter from Daniel Castro, Director, Center for Data Innovation, to Nicole Wong, Big Data Study, Office of Science and Technology Policy (Mar. 31, 2014), *available at* http://www2.datainnovation.org/2014-ostp-big-data-cdi.pdf.

[14] Luke Dormehl, *Internet of Things: It's All Coming Together for a Tech Revolution*, GUARDIAN, June 7, 2014, *available at* http://www.theguardian.com/technology/2014/jun/08/internet-of-things-coming-together-tech-revolution.

[15] Bill Wasik, *Why Wearable Tech Will Be as Big as the Smartphone*, WIRED (Dec. 17, 2013), http://www.wired.com/gadgetlab/2013/12/wearable-computers ("Thanks to what former *Wired* editor in chief Chris Anderson has called the 'peace dividend of the smartphone wars,' sensors and chip sets are cheaper now than ever, making it easier for small companies to incorporate sophisticated hardware into wearable devices." This means, Wasik explains, that "it has become possible for tiny companies to dream up, build, and sell wearable devices in competition with big companies, a feat that was never possible with smartphones.").

[16] Neil Gershenfeld & J. P. Vasseur, *As Objects Go Online*, FOREIGN AFFAIRS, Mar.–Apr. 2014, *available at* http://www.foreignaffairs.com/articles/140745/neil-gershenfeld-and-jp-vasseur/as-objects-go-online.

[17] DAVID ROSE, ENCHANTED OBJECTS: DESIGN, HUMAN DESIRE, AND THE INTERNET OF THINGS 11 (2014) ("[N]ow it seems as if we're getting closer to the Internet of Things, primarily because the price of computation and connectivity has been reduced to almost nothing.").

[18] DAVE EVANS, THE INTERNET OF THINGS: HOW THE NEXT EVOLUTION OF THE INTERNET IS CHANGING EVERYTHING 2 (Apr. 2011), *available at* http://www.cisco.com/web/about/ac79/docs/innov/IoT_IBSG_0411FINAL.pdf.

automated, and communicating.[19] In other words, consumers are transitioning to what Alex Hawkinson, CEO and founder of SmartThings, calls a "programmable world" where "things will become intuitive [and] connectivity will extend even further, to the items we hold most dear, to those things that service the everyday needs of the members of the household, and beyond."[20]

This so-called Internet of Things—or "machine-to-machine" connectivity and communications[21]—promises to usher in "a third computing revolution"[22] and bring about profound changes that will rival the first wave of Internet innovation.[23] The first use of the term *Internet of Things* is attributed to Kevin Ashton, who used it in the title of a 1999 presentation.[24] A decade later, he reflected on the term and its meaning:

> If we had computers that knew everything there was to know about things—using data they gathered without any help from us—we would be able to track and count everything, and greatly reduce waste, loss, and cost. We would know when things needed replacing, repairing, or recalling and whether they were fresh or past their best.
>
> We need to empower computers with their own means of gathering information, so they can see, hear, and smell the world for themselves, in all its random glory. RFID [radio-frequency identification] and sensor technology enable computers to observe, identify, and understand the world—without the limitations of human-entered data.[25]

---

[19] Glen Martin, *Wearable Intelligence: Establishing Protocols to Socialize Wearable Devices*, O'REILLY RADAR (Apr. 1, 2014), http://radar.oreilly.com/2014/04/wearable-intelligence.html ("Intelligent devices other than phones and screens—smart headsets, glasses, watches, bracelets—are insinuating themselves into our daily lives. The technology for even less intrusive mechanisms, such as jewelry, buttons, and implants, exists and will ultimately find commercial applications."). A database of many current wearable technologies can be found at http://vandrico.com/database. *See also* Abigail Tracy, *How the Internet of Things Actually Works [Infographic],* INC. (Mar. 25, 2014), http://www.inc.com/abigail-tracy/inforgraphic-understand-the-internet-of-things.html.

[20] Alex Hawkinson, *What Happens When the World Wakes Up*, MEDIUM (Sept. 23, 2014), https://medium.com/@ahawkinson/what-happens-when-the-world-wakes-up-c73a5c931c17.

[21] John Naughton, *The Internet of Things: It's a Really Big Deal*, GUARDIAN, June 14, 2014, *available at* http://www.theguardian.com/technology/2014/jun/15/networker-internet-of-things-john-naughton-hacking.

[22] Timothy B. Lee, *Everything's Connected: How Tiny Computers Could Change the Way We Live*, VOX (Aug. 13, 2014), http://www.vox.com/2014/5/8/5590228/how-tiny-computers-could-change-the-way-we-live.

[23] Michael Mandel, *Can the Internet of Everything Bring Back the High-Growth Economy?*, POLICY MEMO (Progressive Policy Inst.), Sept. 2013, at 9, *available at* http://www.progressivepolicy.org/2013/09/can-the-internet-of-everything-bring-back-the-high-growth-economy. ("No one can predict the ultimate course of innovative technologies, but it appears that the Internet of Everything has the potential to help revive the high-growth economy.")

[24] Kevin Ashton, *That "Internet of Things" Thing*, RFID JOURNAL (June 22, 2009), http://www.rfidjournal.com/articles/view?4986.

[25] *Id.*

More recently, analysts with Morrison Foerster have defined IoT as "the network of everyday physical objects which surround us and that are increasingly being embedded with technology to enable those objects to collect and transmit data about their use and surroundings."[26] These low-power devices typically rely on sensor technologies[27] as well as existing wireless networking systems and protocols (Wi-Fi, Bluetooth, near field communication, and GPS) to facilitate those objectives.[28] In turn, this reliance will fuel the creation of even more "big data."[29] Many of these technologies and capabilities will eventually operate in the background of consumers' lives and be almost invisible to them.[30]

IoT is sometimes understood as being synonymous with "smart" systems: smart homes,[31] smart buildings,[32] smart appliances,[33] smart health,[34] smart mobility, smart cities,[35] and so on.[36]

---

[26] Amy Collins, Adam J. Fleisher, D. Reed Freeman Jr. & Alistair Maughan, *The Internet of Things Part 1: Brave New World*, CLIENT ALERT (Morrison Foerster), March 18, 2014, at 1, *available at* http://www.jdsupra.com/legal news/the-internet-of-things-part-1-brave-new-23154.

[27] Shawn G. DuBravac, *A Hundred Billion Nodes*, *in* FIVE TECHNOLOGY TRENDS TO WATCH 2014 6, 7 (2014). ("The 'sensor'ization of technology creates a deluge of connected devices digitizing information in near real-time and providing this data in troves to anything they can. . . . There are already hundreds of ways sensors and computing partner with connectivity to create an Internet of Things. All of these systems can become a function of a series of data points captured from a wide swath of sensors. These systems become contextually aware and continuously updated as new information becomes available.")

[28] Rahul Patel, *Where Is Wearable Tech Headed?* GIGAOM (Sept. 28, 2013), http://gigaom.com/2013/09/28/where -is-wearable-tech-headed.

[29] Gil Allouche, *Big Data and the Internet of Things: A Powerful Combination*, SMART DATA COLLECTIVE (June 4, 2014), http://smartdatacollective.com/gilallouche/202371/big-data-and-internet-things-powerful-combination ("What happens, then, when you combine these two seemingly up and coming enigmas? You have an extremely powerful combination. Working together, big data and IoT have the potential to drastically change how things are done.").

[30] DuBravac, *supra* note 27, at 8 ("For the foreseeable future, the Internet of Things will toggle between the visible and invisible world and eventually, a large portion of the Internet of Things will slip into invisibility. Using sensors to collect information digitally, and employing algorithms and computing to utilize this information, a device's ability to self-regulate will increasingly take place in the background.").

[31] Mike Robuck, *Smart Home Survey: 'Internet of Things' Will Take Flight in Five Years*, CED (May 14, 2014), http://www.cedmagazine.com/news/2014/05/smart-home-survey-%E2%80%98internet-of-things%E2%80%99-will -take-flight-in-five-years; Sarah Susanka, *Sarah Susanka Says the Home of the Future Will Be a Portal*, WALL ST. J., July 8, 2014, *available at* http://online.wsj.com/articles/sarah-susanka-says-the-home-of-the-future-will-be-a -portal-1404764842 ("We're hearing a lot of late about "smart homes," but like the Internet in 1995, it hasn't quite caught on yet. Watch out, though. This is one of the big shifts headed our way.").

[32] Mellisa Tolentino, *Smart Building Projects to Boom in 2018*, SILICON ANGLE (Apr. 16, 2014), http://siliconangle .com/blog/2014/04/16/smart-building-projects-to-boom-in-2018.

[33] Yohana Desta, *Why You're Not Seeing More Smart Home Appliances*, MASHABLE (Apr. 26, 2014), http://mashable .com/2014/04/26/smart-home-appliances.

Smart car technology is also expanding rapidly.[37] Some experts even predict that "the automobile could be the first great wearable computer" and "your car might be the second most-used computing device you own before too long."[38] (Intelligent vehicle technology was the subject of another recent working paper published by the Mercatus Center at George Mason University.)[39] The systems undergirding IoT are still evolving rapidly with a variety of wireless technologies and protocols being used to connect these devices and let them communicate.[40] "In blending the physical and digital worlds, we essentially extend the original concept of hyperlinking to include physical objects," notes Shawn G. DuBravac, chief economist and senior director of research for the Consumer Electronics Association (CEA).[41] "The power of these devices, in essence, is their ability to sample information millions of times more often than we as people can," he says.[42]

The promise of IoT, as described by *New York Times* reporter Steve Lohr, is that "billions of digital devices—from smartphones to sensors in homes, cars, and machines of all kinds—will communicate with each other to automate tasks and make life better."[43] "Consumers and public officials can use the connected world to improve energy conservation,

---

[34] James Temple, *The Race to Dominate Digital Health Heats Up*, RE/CODE (June 23, 2014), http://recode.net/2014/06/23/the-race-to-dominate-digital-health-heats-up.
[35] ANTHONY TOWNSEND, SMART CITIES: BIG DATA, CIVIC HACKERS, AND THE QUEST FOR A NEW UTOPIA (2013).
[36] THE INTERNET OF THINGS 2012: NEW HORIZONS 29–31 (Ian G. Smith ed., 2012).
[37] Jonathan M. Gitlin, *The Past, Present, and Future of In-Car Infotainment*, ARS TECHNICA (June 3, 2014), http://arstechnica.com/gadgets/2014/06/the-past-present-and-future-of-in-car-infotainment.
[38] Jonathan M. Gitlin, *Industries Collide: How Automakers Are Adapting to Consumer Tech Life Cycles*, ARS TECHNICA (June 3, 2014), http://arstechnica.com/cars/2014/06/industries-collide-how-automakers-are-adapting-to-consumer-tech-life-cycles.
[39] Adam Thierer & Ryan Hagemann, *Removing Roadblocks to Intelligent Vehicles and Driverless Cars* (Mercatus Center at George Mason University, Mercatus Working Paper, 2014), *available at* http://mercatus.org/publication/removing-roadblocks-intelligent-vehicles-and-driverless-cars.
[40] *See* Patrick Thibodeau, *Explained: The ABCs of the Internet of Things*, COMPUTERWORLD (May 6, 2014), http://www.computerworld.com/s/article/9248058/Explained_The_ABCs_of_the_Internet_of_Things_.
[41] DuBravac, *supra* note 27, at 4.
[42] *Id.* at 6.
[43] Steve Lohr, *A Messenger for the Internet of Things*, N.Y. TIMES BITS (Apr. 25, 2013), http://bits.blogs.nytimes.com/2013/04/25/a-messenger-for-the-internet-of-things.

efficiency, productivity, public safety, health, education, and more," predicts CEA.[44] "The connected devices and applications that consumers choose to adopt will make their lives easier, safer, healthier, less expensive, and more productive."[45] In addition to giving consumers more control over their lives, these technologies can also help them free up time by automating routine tasks and chores.[46] In a new book on these technologies and their promise, David Rose of the Massachusetts Institute of Technology Media Lab describes an emerging world of "enchanted objects," which are objects that "start as ordinary things," but then are "augmented and enhanced through the use of emerging technologies—sensors, actuators, wireless connection, and embedded processing—so that it becomes extraordinary."[47] Through this transformation from ordinary to extraordinary, the newly enchanted object "evokes an emotional response from you and enhances your life," he argues.[48]

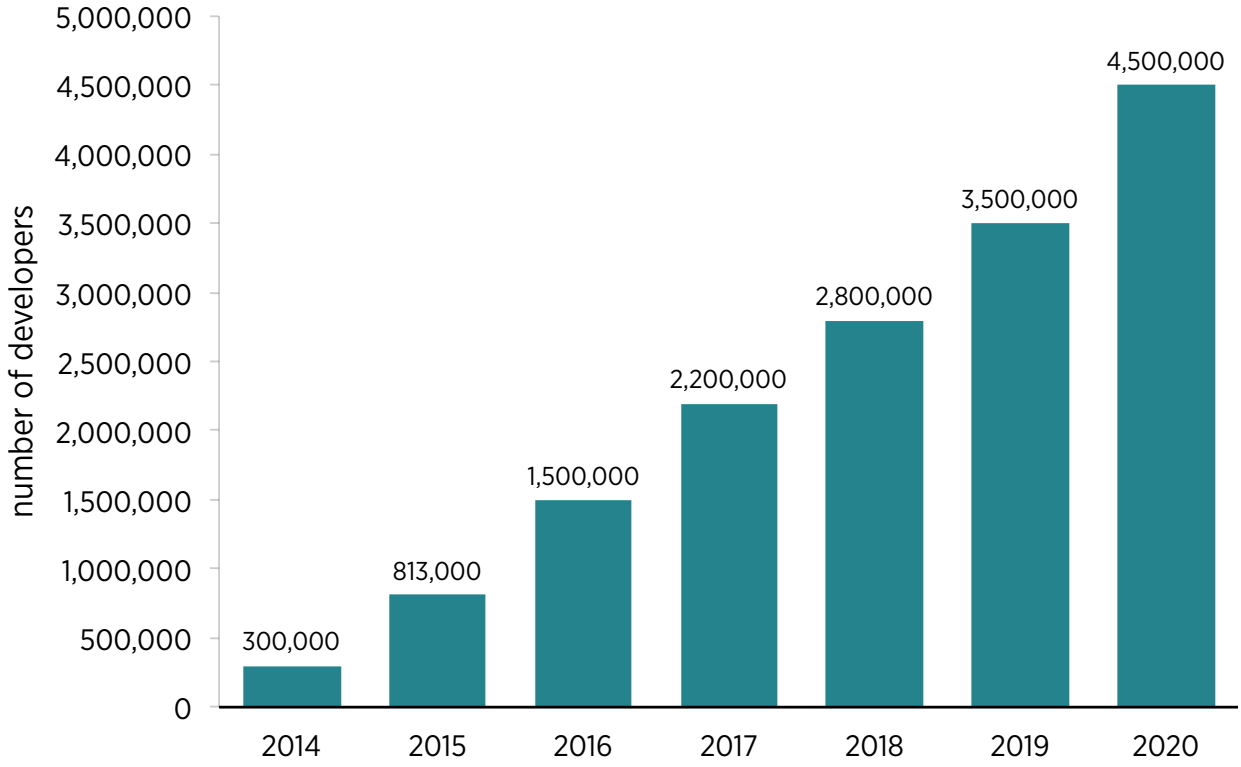
This technological "enchantment" is already occurring at a breakneck pace. According to Dave Evans of Cisco, by 2020, 37 billion intelligent things will be connected and communicating.[49] Thus, society is rapidly approaching the point where "everyone and everything will be connected to the network."[50] ABI Research estimates that there are more than 10 billion wirelessly connected devices in the market today and more than 30 billion devices expected by

---

[44] Consumer Electronics Association, cmt. to the Fed. Trade Comm'n on Internet of Things, Project No. P135405 (June 10, 2013), at 7.
[45] *Id.*
[46] Daniel Castro, *Algorithms and Automation Will Give Us More Freedom and Control*, IDEAS LAB (July 8, 2014), http://www.ideaslaboratory.com/2014/07/08/algorithms-and-automation-will-give-us-more-freedom-and-control ("Because as more processes are put on autopilot, we will unyoke ourselves from routine tasks and enjoy the freedom to help those on the margins.").
[47] Rose, *supra* note 17, at 47.
[48] *Id.*
[49] Dave Evans, *Thanks to IoE, the Next Decade Looks Positively 'Nutty,'* CISCO BLOG (Feb. 12, 2013), http://blogs.cisco.com/ioe/thanks-to-ioe-the-next-decade-looks-positively-nutty.
[50] RFID WORKING GROUP OF THE EUROPEAN TECHNOLOGY PLATFORM ON SMART SYSTEMS INTEGRATION, INTERNET OF THINGS IN 2020: A ROADMAP FOR THE FUTURE 21 (Sept. 5, 2008), *available at* http://www.smart-systems-integration.org/public/documents/publications/Internet-of-Things_in_2020_EC-EPoSS_Workshop_Report_2008_v3.pdf.

2020.[51] The consultancy IDC (International Data Corporation) predicts far greater penetration of 212 billion installed devices by that year.[52] VisionMobile projects that the number of IoT developers will grow from roughly 300,000 in 2014 to more than 4.5 million by 2020 (figure 1).[53]

Figure 1. Estimated Number of Internet of Things Developers, 2014–2020



Source: VisionMobile (June 2014).

[51] Press Release, ABI Research, More Than 30 Billion Devices Will Wirelessly Connect to the Internet of Everything in 2020 (May 9, 2013), available at https://www.abiresearch.com/press/more-than-30-billion-devices-will-wirelessly-conne.

[52] Jaikumar Vijayan, *The Internet of Things Likely to Drive an Upheaval for Security*, COMPUTERWORLD (May 2, 2014), http://www.computerworld.com/s/article/9248069/The_Internet_of_Things_likely_to_drive_an_upheaval_for_security.

[53] Matt Asay, *The Internet of Things Will Need Millions of Developers by 2020*, READWRITE (June 27, 2014), http://readwrite.com/2014/06/27/internet-of-things-developers-jobs-opportunity.

The benefits associated with these developments could be enormous.[54] McKinsey Global Institute researchers estimate the potential economic impact of IoT to be $2.7 trillion to $6.2 trillion per year by 2025,[55] and IDC estimates that this market will grow at a compound annual growth rate of 7.9% between now and 2020, to reach $8.9 trillion.[56] Cisco analysts estimate that IoT will create $14.4 trillion in value between 2013 and 2022.[57] Many other analysts and consultancies have predicted similar growth and economic impacts[58] and agree with Michael Mandel, chief economic strategist at the Progressive Policy Institute, who argues that the positive effects could reverberate throughout the economy.[59] Mandel believes that "we are at the next stage of the Internet Revolution" and that "the Internet of Everything has the potential to help revive the high-growth economy."[60]

The biggest impacts will likely be in health care, energy, transportation, and retail services. But governments will benefit too. "Governments are deploying sensors to alert them to failed street lights, leaks in water systems, and full trash cans. Sensors will likely have a major role in traffic control, fighting forest fires, and landslide detection."[61]

---

[54] Emily Adler, *The 'Internet of Things' Will Soon Be a Truly Huge Market, Dwarfing All Other Consumer Electronics Categories*, BUSINESS INSIDER (July 10, 2014), http://www.businessinsider.com/internet-of-things-will-soon-be-a-truly-huge-market-dwarfing-all-other-consumer-electronics-categories-2014-7.

[55] JAMES MANYIKA, MICHAEL CHUI, JACQUES BUGHIN, RICHARD DOBBS, PETER BISSON & ALEX MARRS, DISRUPTIVE TECHNOLOGIES: ADVANCES THAT WILL TRANSFORM LIFE, BUSINESS, AND THE GLOBAL ECONOMY (May 2013), *available at* http://www.mckinsey.com/insights/business_technology/disruptive_technologies.

[56] Antony Savvas, *Internet of Things Market Will Be Worth Almost $9 Trillion*, CNME (Oct. 6, 2013), http://www.cnmeonline.com/news/internet-of-things-market-will-be-worth-almost-9-trillion.

[57] JOSEPH BRADLEY, JOEL BARBIER & DOUG HANDLER, EMBRACING THE INTERNET OF EVERYTHING TO CAPTURE YOUR SHARE OF $14.4 TRILLION (2013), *available at* http://www.cisco.com/web/about/ac79/docs/innov/IoE_Economy.pdf.

[58] Gil Press, *Internet of Things by the Numbers: Market Estimates and Forecasts*, FORBES (Aug. 22, 2014), http://www.forbes.com/sites/gilpress/2014/08/22/internet-of-things-by-the-numbers-market-estimates-and-forecasts.

[59] Mandel, *supra* note 23, at 9.

[60] *Id.*

[61] Thibodeau, *supra* note 40.

But that just scratches the surface of potential money-saving and life-saving applications for IoT technologies.[62] IoT technologies will produce benefits for firms and consumers. Many of these benefits will come about only after data is collected and used for entirely new purposes.

For firms, "IoT has great potential to generate new sources of revenue, improve efficiencies, and allow businesses to both increase profits and cut costs."[63] IoT will have many important applications for traditional manufacturing industries as well.[64] General Electric coined the term *Industrial Internet* to explain how "the advent of networked machines with embedded sensors and advanced analytics tools" could revolutionize industrial machinery in coming years.[65] This "the fourth industrial revolution"[66] could result in improved efficiencies and significant cost savings.[67]

For consumers, IoT technologies will offer a staggering array of new devices and service options that will make their lives and jobs easier.[68] That is especially the case with the subset of IoT technologies known as *wearables*, which will be discussed extensively throughout this paper.

---

[62] Daniel Castro & Travis Korte, *Data Innovation 101: An Introduction to the Technologies and Policies Supporting Data-Driven Innovation*, CENTER FOR DATA INNOVATION (Nov. 4, 2013), http://www.datainnovation.org/2013/11/data-innovation-101.

[63] Collins et al., *supra* note 26, at 3.

[64] Steve Lohr, *The Internet Gets Physical*, N.Y. TIMES, Dec. 17, 2011, *available at* http://www.nytimes.com/2011/12/18/sunday-review/the-internet-gets-physical.html.

[65] General Electric, *What Is the Industrial Internet?*, https://www.gesoftware.com/industrial-internet (last visited Oct. 30, 2014).

[66] Chloe Green, *The Internet of Things Business Process Revolution*, INFORMATION AGE (Sept. 10, 2014), http://www.information-age.com/it-management/strategy-and-innovation/123458453/internet-things-business-process-revolution.

[67] Jon Bruner, *Defining the Industrial Internet*, O'REILLY RADAR (Jan. 11, 2013), http://radar.oreilly.com/2013/01/defining-the-industrial-internet.html.

[68] *See generally* DANIEL CASTRO & JORDAN MISRA, THE INTERNET OF THINGS (Nov. 2013), *available at* http://www2.datainnovation.org/2013-internet-of-things.pdf.

B. The Expanding World of Wearables

In its massive 2002 report titled *Converging Technologies for Improving Human Performance*, the U.S. National Science Foundation predicted that, within the next two decades, "Comfortable, wearable sensors and computers will enhance every person's awareness of his or her health condition, environment, chemical pollutants, potential hazards, and information of interest about local businesses, natural resources, and the like."[69] Twelve years later, the future that the National Science Foundation predicted is starting to emerge.

Although rudimentary wearable technologies—such as calculator wristwatches, hearing aids, and Bluetooth-enabled communications headsets—have been on the market for many years, this market is now expanding quite rapidly.[70] Even though "wearables are still looking for their killer app,"[71] health and fitness wearables are already widely used today.[72] Popular examples include the FitBit and Jawbone wearable fitness bracelets, which have been on the market for several years and command the bulk of market share.[73] The so-called quantified self movement refers to individuals who use such digital logging tools to continuously track their daily activity and well-being.[74] Many users share their data with others to compare results and provide "instant

---

[69] CONVERGING TECHNOLOGIES FOR IMPROVING HUMAN PERFORMANCE 5 (Mihail C. Roco & William Sims Bainbridge eds., 2002), *available at* http://www.wtec.org/ConvergingTechnologies/Report/NBIC_report.pdf.
[70] Max Knoblauch, *The History of Wearable Tech, from the Casino to the Consumer*, MASHABLE (May 13, 2014), http://mashable.com/2014/05/13/wearable-technology-history.
[71] Rachel Metz, *The Internet of You*, MIT TECH. REV. (May 20, 2014), http://www.technologyreview.com/news/527386/the-internet-of-you.
[72] *Health and Appiness*, ECONOMIST, Feb. 1, 2014, *available at* http://www.economist.com/news/business/21595461-those-pouring-money-health-related-mobile-gadgets-and-apps-believe-they-can-work; Brian Bennett, *Wearable Tech Multiplies and Goes Mainstream at MWC 2014*, CNET (Feb. 27, 2014), http://reviews.cnet.com/8301-13970_7-57619658-78/wearable-tech-multiplies-and-goes-mainstream-at-mwc-2014.
[73] Dara Kerr, *Fitbit Rules 50 Percent of the World's Wearable Market*, CNET (May 21, 2014), http://www.cnet.com/news/fitbit-rules-50-percent-of-the-worlds-wearable-market.
[74] *The Quantified Self: Counting Every Moment*, ECONOMIST, Mar. 3, 2012, *available at* http://www.economist.com/node/21548493; Deborah Lupton, *Understanding the Human Machine*, IEEE TECHNOLOGY AND SOCIETY MAGAZINE (Winter 2013), at 25, *available at* https://www.academia.edu/5392119/Understanding_the_human_machine.

feedback"[75] by, for example, notifying individuals about how many steps they have taken or buzzing (or even shocking them)[76] to remind them to be more active. Users of fitness bracelets often share results and compete for "step supremacy."[77]

As they grow more sophisticated, wearable health devices will help users track and even diagnose various conditions and potentially advise a course of action or, more simply, remind users to take medications or contact medical professionals as necessary.[78] In the process, these health and fitness devices and applications could eventually become "lifestyle remotes" that help consumers control or automate many other systems around them, regardless of whether they are in their homes, offices, cars, or the like.[79] As a result, wearables will have even more uniquely personal properties and capabilities than the broader IoT, which will raise special privacy concerns discussed later in this paper.

These wearable technologies are gaining more widespread public visibility and now even have their own product section on Amazon.com.[80] According to research firm Canalys, there was a 700% growth in the market for wearable smart bands in the second half of 2013 over the first half.[81] IDC reports that "wearables took a huge step forward over the past year, and shipment

---

[75] Katrina Plyler, *What Is Everybody Wearing? Fitness Tech Gadgets!*, U.S. NEWS & WORLD REPORT, Apr. 11, 2014, *available at* http://health.usnews.com/health-news/blogs/eat-run/2014/04/11/what-is-everybody-wearing-fitness-tech-gadgets?int=9a5208.

[76] James Trew, *Pavlok Is a Habit-Forming Wearable That Will Shock You*, ENGADGET (July 4, 2014), http://www.engadget.com/2014/07/04/pavlok-wearable.

[77] Michael S. Rosenwald, *A New Washington Rat Race: Fitbit-Wearing Power Walkers vie for Step Supremacy*, WASH. POST, Sept. 16, 2014, *available at* http://www.washingtonpost.com/local/a-new-washington-rat-race-fitbit-wearing-power-walkers-vie-for-step-supremacy/2014/09/16/63022b5c-39e9-11e4-9c9f-ebb47272e40e_story.html.

[78] Nathan Olivarez-Giles, *WebMD Relaunches iPhone App as a Hub for Fitness Data,* WALL ST. J., June 16, 2014, *available at* http://blogs.wsj.com/personal-technology/2014/06/16/webmd-relaunches-iphone-app-as-a-hub-for-fitness-data.

[79] *See* Metz, *supra* note 71; DuBravac, *supra* note 27, at 7–8.

[80] Hayley Tsukayama, *Wearable Tech Grows Enough to Get Its Own Section on Amazon*, WASH. POST, Apr. 29, 2014, *available at* http://www.washingtonpost.com/blogs/the-switch/wp/2014/04/29/wearable-tech-grows-enough-to-get-its-own-section-on-amazon.

[81] Matt Clinch, *Wearable Smart Bands Set for 350% Growth in 2014*, CNBC (Feb. 12, 2014), http://www.cnbc.com/id/101410507.

volumes will exceed 19 million units in 2014, more than tripling last year's sales. From there, they predict that the global market will swell to 111.9 million units in 2018, resulting in a CAGR [compound annual growth rate] of 78.4%."[82] *Hearables*, or small devices worn in the ear to provide users with relevant real-time information, are also expected to become a major part of the wearable market in coming years.[83] One wireless analyst estimates that such "smart earbuds" could constitute a $5 billion market by 2018.[84]

Major smartphone and tablet developers such as Apple[85] and Samsung[86] are also getting more active in this space, which will likely give these applications and services even greater visibility. Beyond their touch screens and wireless networking capabilities, modern smartphones include sensors, accelerometers, cameras, microphones, and other capabilities that can be used to collect and transmit various types of user information. At a summer 2014 conference for developers, Apple "unveiled plans to let people use their iPhones and iPads to control an array of Internet-connected devices in their homes, from door locks to lightbulbs."[87] Apple simultaneously launched "HealthKit," which will "help apps, third party devices and healthcare services collect, quantify, and share your health data . . . [and] could change the way you track

---

[82] Press Release, IDC, Worldwide Wearable Computing Market Gains Momentum with Shipments Reaching 19.2 Million in 2014 and Climbing to Nearly 112 Million in 2018, Says IDC (Apr. 10, 2014), *available at* http://www.idc.com/getdoc.jsp?containerId=prUS24794914.

[83] Jessica Glazer, *Psst! Wearable Devices Could Make Big Tech Leaps, into Your Ear*, NPR ALL TECH CONSIDERED (Apr. 29, 2014), http://www.npr.org/blogs/alltechconsidered/2014/04/23/306171641/psst-wearable-devices-could-make-big-tech-leaps-into-your-ear.

[84] Rachel Feltman, *The Next Big Thing in Wearable Tech May Be Ear Computers*, QUARTZ (Apr. 10, 2014), http://qz.com/196886/the-next-big-thing-in-wearable-tech-may-be-ear-computers/#/h/60425,2/.

[85] Hannah Ishmael, *Apple's HealthKit Platform: Revolutionizing the Healthcare Industry*, BIDNESS ETC (July 3, 2014), http://www.bidnessetc.com/business/apples-healthkit-platform-revolutionizing-the-healthcare-industry.

[86] Stacey Higginbotham, *Samsung Launches a Wearable Wristband and Cloud Platform for Tracking Your Health*, GIGAOM (May 28, 2014), https://gigaom.com/2014/05/28/samsung-launches-a-wearable-and-cloud-platform-for-tracking-your-health; *Samsung Unwraps Tizen for "Internet of Things,"* TAIPEI TIMES, June 5, 2014, *available at* http://www.taipeitimes.com/News/biz/archives/2014/06/05/2003592005.

[87] Erin Mershon, *Apple Dives into "Internet of Things,"* POLITICO (June 2, 2014), http://www.politico.com/story/2014/06/apple-wwdc-2014-internet-of-things-107336.html#ixzz33hMxZTIN.

and manage your well-being."[88] Google promptly responded with a competing service called Google Fit.[89]

Flurry Analytics has found that usage of health and fitness apps is up sixty-two percent in the past six months compared to thirty-three percent growth for the entire market of other applications, an eighty-seven percent faster pace.[90] The firm reports that there are more than 6,800 apps in the health and fitness category on the iPhone and iPad today.[91] Meanwhile, Samsung's newest phones can measure a user's heart rate and also feature extensive integration with fitness-tracking applications made by Samsung as well as other developers.[92]

Microsoft also recently announced it would be "making home automation even easier for everyone, from the ultra-techie to the average homeowner" by integrating IoT technologies into tablets running Windows 8.1 as well as Windows Phone.[93] Microsoft is also developing a wearable band that will help blind people navigate their surroundings.[94] Also, Google, which earlier made a major splash in this space by developing Google Glass, recently announced it will develop a wearable-specific variant of its Android mobile operating system to optimize the developer and user experience of devices of that size.[95] Google also recently patented "smart contact lenses" (otherwise known as *ophthalmic electrochemical sensors*) that will help diabetics

---

[88] Lance Ulanoff, *Inside HealthKit: Apple's Answer to the Quantified You*, MASHABLE (June 3, 2014), http://mashable.com/2014/06/03/inside-apple-healthkit.
[89] Ben Gilbert, *Google Fit Is Android's Answer to Exercise and Health Tracking*, ENGADGET (June 26, 2014), http://www.engadget.com/2014/06/25/google-fit.
[90] Kyle Russell, *Fitness App Usage Is Growing 87% Faster Than the Overall App Market*, TECH CRUNCH (June 19, 2014), http://techcrunch.com/2014/06/19/fitness-app-usage-is-growing-87-faster-than-the-overall-app-market.
[91] *Id.*
[92] Tom Warren, *Samsung's Free Galaxy S5 "Gifts" Focus on Fitness*, VERGE (Mar. 10, 2014).
[93] Daniel Kline, *How Microsoft Will Incorporate the Internet of Things into Windows 8.1*, MOTLEY FOOL (May 20, 2014), http://www.fool.com/investing/general/2014/05/20/how-microsoft-will-incorporate-the-internet-of-thi.aspx.
[94] Jack Schofield, *Microsoft's Wearable Alice Band Is Not a Rival to Google Glass*, ZDNET (July 14, 2014), http://www.zdnet.com/microsofts-wearable-alice-band-is-not-a-rival-to-google-glass-7000031563.
[95] Hayley Tsukayama, *Google Develops Android for Wearables You May Actually Want to Wear*, WASH. POST THE SWITCH (Mar. 18, 2014), http://www.washingtonpost.com/blogs/the-switch/wp/2014/03/18/google-develops-android-for-wearables-you-may-actually-want-to-wear.

more easily monitor their blood sugar levels and that could also lead to other wearable medical applications in the future.[96]

Many current-generation wearables are clunky and unsightly, which probably has limited their adoption to some degree.[97] But "sensor-rich fabric"[98] and "conductive fiber" technologies are now proliferating, meaning that "fabric itself can now become an electronic device, allowing wearables to be incorporated into the most stylish clothing," as *The Economist* recently noted.[99] These conductive fibers are flexible and resilient, which "means they can be fed into a loom or embroidered directly onto cloth that can be worn and washed as normal. With costs falling and use increasing, the threads are a rapidly growing business."[100] Meanwhile, technology developers are working actively to make these wearable devices more fashionable.[101]

The medical monitoring capabilities associated with wearable technologies are particularly compelling. Eric Topol, author of *The Creative Destruction of Medicine: How the Digital Revolution Will Create Better Health Care*, predicts that "in the coming years, we'll see apps and adds for measuring blood glucose, sleep brain waves, and all vital signs, stress, and

---

[96] Kia Makarechi, *Move Over, Google Glass; Here Come Google Contact Lenses*, VANITY FAIR (Apr. 22, 2014), http://www.vanityfair.com/online/daily/2014/04/google-contact-lenses; Lance Ulanoff, *Google Smart Contact Lenses Move Closer to Reality*, MASHABLE (Apr. 21, 2014), http://mashable.com/2014/04/21/google-smart-contact-lenses-patents/#:eyJzIjoidCIsImkiOiJfbXBtazRkemRvdWttcXQ4byJ9.

[97] Connie Guglielmo, *The Case against Wearables, or Why We Won't All Look Like the Borg This Year*, FORBES Mar. 3, 2014, *available at* http://www.forbes.com/sites/connieguglielmo/2014/02/12/the-case-against-wearables; Nick Warnock, "Wearable Tech: Fashion Will Rule," INFORMATIONWEEK (June 18, 2014), http://www.informationweek.com/strategic-cio/digital-business/wearable-tech-fashion-will-rule/a/d-id/1278629?_mc=sm_iwk_edit.

[98] Stacey Higginbotham*, You Call Google Glass Wearable Tech? Heapsylon Makes Sensor-Rich Fabric*, GIGAOM (May 16, 2013), http://gigaom.com/2013/05/16/you-call-google-glass-wearable-tech-heapsylon-makes-sensor-rich-fabric.

[99] *Woven Electronics: An Uncommon Thread*, ECONOMIST, Mar. 8, 2014, *available at* http://www.economist.com/news/technology-quarterly/21598328-conductive-fibres-lighter-aircraft-electric-knickers-flexible-filaments.

[100] *Id.*

[101] Nick Bilton, *Tech, Meet Fashion*, N.Y. TIMES, Sept. 3, 2014, *available at* http://www.nytimes.com/2014/09/04/fashion/intel-and-opening-ceremony-collaborate-on-mica-a-stylish-tech-bracelet.html?_r=0; Elizabeth Holmes, *Tech Companies and Fashion Designers Try to Put the 'Wear' in 'Wearables*,*'* WALL ST. J., Sept. 9, 2014, *available at* http://online.wsj.com/articles/tech-companies-and-fashion-designers-try-to-put-the-wear-in-wearables-1410305929.

mood quantified. Measuring vitals will eventually be as common as counting calories or the number of steps you've walked."[102]

Many elderly individuals are already using wearable technologies to ensure they can report medical emergencies to caregivers and family members.[103] Medical Body Area Network (MBAN) sensors in professional health care are also set to take off. MBAN sensors "will enable patient monitoring information such as temperature to be collected automatically from a wearable thermometer sensor."[104] South Korean scientists have already developed a flexible electronic skin patch "that's thinner than a sheet of paper and can detect subtle tremors, release drugs stored inside nanoparticles on-demand, and record all of this activity for review later."[105] Also, health technology provider MC10 has created Biostamp, a thin, bandage-like sensor patch that can be worn anywhere on the body to "monitor temperature, movement, heart rate, and more, and transmit this data wirelessly back to patients and their clinicians."[106]

Many other medical and health-related wearable applications that take advantage of the aforementioned smartphone and tablet capabilities are already on the market. Nathan Cortez of the Southern Methodist University School of Law has developed a six-part typology of mobile health applications, some of which potentially butt up against existing Food and Drug

---

[102] ERIC TOPOL, THE CREATIVE DESTRUCTION OF MEDICINE: HOW THE DIGITAL REVOLUTION WILL CREATE BETTER HEALTH CARE 260 (2012).
[103] Susan Young, *An Activity Tracker for Seniors*, MIT TECH. REV. (Feb. 27, 2014), http://www.technologyreview.com/news/525016/an-activity-tracker-for-seniors.
[104] Press Release, ABI Research, Disposable Wireless Sensor Market Shows Signs of Life: Healthcare Shipments to Reach 5 Million in 2018 (May 3, 2013), *available at* http://www.abiresearch.com/press/disposable-wireless-sensor-market-shows-signs-of-l.
[105] David Talbot, *A Bandage That Senses Tremors, Delivers Drugs, and Keeps a Record*, MIT TECH. REV. (Apr. 1, 2014), http://www.technologyreview.com/news/525976/a-bandage-that-senses-tremors-delivers-drugs-and-keeps-a-record.
[106] Sindya N. Bhanoo, "When Wearable Tech Saves Your Life, You Won't Take It Off," FAST COMPANY (July 23, 2014), http://www.fastcompany.com/3033417/when-wearable-tech-saves-your-life-you-wont-take-it-off.

Administration (FDA) regulatory authority (table 1).[107] In September 2013, the FDA issued draft guidance for mobile medical applications, which attempted to explain which mobile health apps qualified as regulated "medical devices" and which did not.[108] The agency noted that it "intends to apply its regulatory oversight to only those mobile apps that are medical devices and whose functionality could pose a risk to a patient's safety if the mobile app were to not function as intended."[109] Legislation has also been floated that would clarify the FDA's regulatory authority in this area.[110] Meanwhile, health insurance providers are starting to experiment with wearables to offer customers more tailored plans and premiums, which will likely drive greater regulatory interest.[111]

Table 1. Typology of Mobile Health Technologies

Connectors: applications that connect smartphones and tablets to FDA-regulated devices, thus amplifying the devices' functionalities.
Replicators: applications that turn a smartphone or tablet itself into a medical device by replicating the functionality of an FDA-regulated device.
Automators and customizers: apps that use questionnaires, algorithms, formulas, medical calculators, or other software parameters to aid clinical decisions.
Informers and educators: medical reference texts and educational apps that primarily aim to inform and educate.
Administrators: apps that automate office functions, like identifying appropriate insurance billing codes or scheduling patient appointments.
Loggers and trackers: apps that allow users to log, record, and make decisions about their general health and wellness.

Source: Nathan Cortez, *The Mobile Health Revolution?*, 47 U.C. Davis L. Rev. 1181 (2014), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2284448.

[107] Nathan Cortez, *The Mobile Health Revolution?*, 47 U.C. DAVIS L. REV. 1181 (2014), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2284448.
[108] FOOD AND DRUG ADMINISTRATION, MOBILE MEDICAL APPLICATIONS: GUIDANCE FOR INDUSTRY AND FOOD AND DRUG ADMINISTRATION STAFF (Sept. 25, 2013), *available at* http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/ConnectedHealth/MobileMedicalApplications/default.htm.
[109] *Id.* at 4.
[110] Ferdous Al-Faruque, *Are smartphones the Best Medicine?*, HILL (June 17, 2014), http://thehill.com/policy/technology/209534-are-smartphones-the-best-medicine.
[111] Parmy Olson, *Wearable Tech Is Plugging into Health Insurance*, FORBES (June 19, 2014), http://www.forbes.com/sites/parmyolson/2014/06/19/wearable-tech-health-insurance.

Beyond health and fitness applications, wearables can be used to enhance personal convenience. For example, wearables can be used in homes to tailor environmental experiences, such as automatically adjusting lighting, temperature, or entertainment options as users move from one space to another. Even if these technologies do not catch on as mass-market consumer products, wearable technology may come to be more widely used in a variety of business and organizations.[112] Some of the more exciting potential professional uses of wearable technology include the following:

- **Surgery:** Surgeons are already using wearable technology to better perform complex procedures, and in the future, wearable technology might be able to help them do this remotely.[113]
- **Emergency care:** Ambulances can be equipped with various IoT devices to more quickly diagnose what ails patients and then provide immediate treatment in the precious minutes after accidents or other health emergencies.[114]
- **Firefighting:** In coming years, firefighters might use wearable technology to respond to fires and other emergencies more rapidly using heads-up displays to obtain instant readouts of building schematics or environmental conditions.[115]

---

[112] H. James Wilson, *Wearables in the Workplace*, HARVARD BUSINESS REVIEW, Sept. 2013, *available at* http://hbr.org/2013/09/wearables-in-the-workplace/ar/1; Claire Cain Miller, *At Google, Bid to Put Its Glasses to Work*, N.Y. TIMES, Apr. 7, 2014, *available at* http://www.nytimes.com/2014/04/08/technology/google-begins-a-push-to-take-glass-to-work.html.

[113] Derek Mead, *Google Glass Is Already Being Used in the Operating Room*, MOTHERBOARD (June 24, 2013), http://motherboard.vice.com/blog/google-glass-is-already-being-used-in-the-operating-room; Liz Gannes, *A Google Glass App That Would Be Hard for Even the Haters to Hate*, RE/CODE (Apr. 8, 2014), http://recode.net/2014/04/08/a-google-glass-app-that-would-be-hard-for-even-the-haters-to-hate; Susan Young Rojahn, *Why Some Doctors Like Google Glass So Much*, MIT TECH. REV. (May 6, 2014), http://www.technologyreview.com/news/526836/why-some-doctors-like-google-glass-so-much.

[114] Maria K. Regan, "Saving Lives: Ambulances Get Connected to the IoT," PTC PRODUCT LIFECYCLE STORIES (July 25, 2014), http://blogs.ptc.com/2014/07/25/saving-lives-ambulances-get-connected-to-the-iot.

[115] Joanie Ferguson, *Firefighter Creates Google Glass App to Help Save Lives*, DAILY DOT (Mar. 5, 2013), http://www.dailydot.com/technology/firefighter-google-glass-app.

- **Law enforcement:** Wearables could transform the field of law enforcement but also raise some surveillance concerns in the process. Importantly, however, average citizens will also be able to use wearable technologies to monitor the activities of those same law enforcement officials.[116] They will have the First Amendment right to do so.[117] This technology could provide a powerful check on abusive behavior by law enforcement officers, while giving those officers the ability to corroborate their accounts of incidents and altercations.[118]
- **Retailing:** Retailers will be able to target shoppers with personalized services and promotions either inside their stores or before the customers even arrive.[119] "As wearable technology gains popularity and becomes integrated into everyday life," says Giovanni DeMeo, vice president of global marketing and analytics at Interactions, it will help

[116] Steve Mann, *Eye Am a Camera: Surveillance and Sousveillance in the Glassage,* TIME, Nov. 2, 2012, *available at* http://techland.time.com/2012/11/02/eye-am-a-camera-surveillance-and-sousveillance-in-the-glassage; Alex Howard, *The "Right to Record" Is Not a Question of Technology, but Rather Power and Policy*, TECH REPUBLIC (May 22, 2014), http://www.techrepublic.com/article/the-right-to-record-is-not-a-question-of-technology-but-rather-power-and-policy/#.

[117] *Recording Police Officers and Public Officials*, DIGITAL MEDIA LAW PROJECT (Dec. 18, 2013), http://www.dmlp.org/legal-guide/recording-police-officers-and-public-officials%20 ("A number of U.S. Courts of Appeals have held that, in such circumstances, the First Amendment protects the right to record audio and video regardless of whether the police/officials consent. This constitutional right would override any state or federal laws that would otherwise prohibit such recording."). *See also* Marianne F. Kies, *Policing the Police: Freedom of the Press, the Right to Privacy, and Civilian Recordings of Police Activity*, 80 GEO. WASH. L. REV. 274 (2011/12); Steven A. Lautt, *Sunlight Is Still the Best Disinfectant: The Case for a First Amendment Right to Record the Police*, 51 WASHBURN L.J. 349 (2011/12); Michael Potere, *Who Will Watch the Watchmen: Citizens Recording Police Conduct*, 106 Nw. U. L. REV. 273 (2012).

[118] Tim Cushing, *After Two Officers Are Indicted for Shooting Citizens, Dallas Police Dept. Decides Body Cameras Might Be a Good Idea*, TECHDIRT (May 20, 2014), http://www.techdirt.com/articles/20140507/10325727152/after-two-officers-are-indicted-shooting-citizens-dallas-police-dept-decides-body-cameras-might-be-good-idea.shtml.

[119] Angela Benton, *Angela Benton on the Future of Entrepreneurship*, WALL ST. J., July 7, 2014, *available at* http://online.wsj.com/articles/angela-benton-on-the-future-of-entrepreneurship-1404762819 ("[IoT presents] the opportunity for budding entrepreneurs of the future to access an individual's data and get a 360-degree view of that person. If you think the recommendation engines of today are good, wait until you see what the future holds. Every business and startup will compete to get to a customer at the perfect moment and with the perfect product that is so 'uniquely' them . . . .").

retailers "establish a strong connection with shoppers" and also "provide a unique and improved shopping experience."[120]

- **Entertainment services:** Like retailers, entertainment companies, amusement parks, and vacation providers will also be able to use wearables to tailor services to users who visit their establishments or use their services. Disney has already created MagicBand, which can help those who will visit Disney's entertainment parks to personalize their experiences before they even get to the facilities.[121]
- **Airlines:** Some airlines are experimenting with wearable technologies "in a quest to provide an ever more personal service" and to "allow them to compile valuable information about passenger behaviors and preferences."[122]
- **Financial services:** Providers of personal finance and investment services are considering how wearable technologies might be adapted to better inform consumers of superior spending and investment opportunities.[123]
- **Political campaigning:** Politicians and "political professionals are eagerly exploring how [Google Glass] could become a powerful campaign tool" and how wearable technologies could help engage potential voters.[124]

---

[120] Giovanni DeMeo, *Wearable Tech: If It Benefits You, It Benefits Retailers*, VENTUREBEAT (Dec. 24, 2013), http://venturebeat.com/2013/12/24/wearable-tech-if-it-benefits-you-it-benefits-retailers.
[121] Matthew Panzarino, *Disney Gets into Wearable Tech with the MagicBand*, NEXT WEB (May 29, 2013), http://the nextweb.com/insider/2013/05/29/disney-goes-into-wearable-tech-with-the-magic-band.
[122] *Airlines Use Wearables to Get More Personal*, N.Y. TIMES BITS (Mar. 18, 2014), http://bits.blogs.nytimes.com /2014/03/18/daily-report-airlines-use-wearables-to-get-more-personal.
[123] Daniel Nader, *The Quantified Self Movement Reaches Personal Finance*, INSTITUTIONAL INVESTOR (Mar. 4, 2014), http://www.institutionalinvestor.com/Article/3315313/Banking-and-Capital-Markets-Trading-and -Technology/The-Quantified-Self-Movement-Reaches-Personal-Finance.html.
[124] Don Gonyea, *Google Glass: Coming Soon to a Campaign Trail Near You*, NPR ITS ALL POLITICS (Mar. 17, 2014), http://www.npr.org/blogs/itsallpolitics/2014/03/17/290714189/google-glass-coming-soon-to-a-campaign -trail-near-you.

- **Sports:** Teams and athletes may use wearables not only to improve their own abilities but also to potentially give fans an additional ways to see how they practice or even play their games.[125]

C. The Sci-Fi Future of Wearables: "Implantables," "Ingestibles," and "Biohacking"

Wearable technologies will continue to evolve and could offer applications that might seem to have been ripped from the pages of science fiction novels.[126] For example, implantables, embeddables, and even ingestibles are already emerging as the next wave of wearable technology.[127] These technologies are now worn somewhere on the body, but they might in the future be swallowed or implanted within the body, potentially even in people's brains.[128] Some current examples include the following:

- SetPoint Medical, which was recently profiled by the *New York Times*, "began the world's first clinical trial to treat rheumatoid-arthritis patients with an implantable nerve stimulator."[129] The implant is roughly the size of a dime. "To recharge the device's

[125] Claire Cain Miller, *At Google, Bid to Put Its Glasses to Work*, N.Y. TIMES, Apr. 7, 2014, *available at* http://www.nytimes.com/2014/04/08/technology/google-begins-a-push-to-take-glass-to-work.html ("Basketball players for the Sacramento Kings and Indiana Pacers have worn [Google] Glass with software from CrowdOptic to broadcast video streams to fans from their points of view, as well as during practice. It gives coaches a different view and a better understanding of court spacing and ball rotation, said Chris Granger, the Kings' chief operating officer . . . .").
[126] Daxton "Chip" Stewart, *Do Androids Dream of Electric Free Speech? Visions of the Future of Copyright, Privacy, and the First Amendment in Science Fiction*, 19 COMM. L. & POL'Y 433, *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2439423.
[127] Cadie Thompson, *Wearable Tech Is Getting a Lot More Intimate*, ENTREPRENEUR (Dec. 26, 2013), http://www.entrepreneur.com/article/230555; George Skidmore, *Ingestible, Implantable, or Intimate Contact: How Will You Take Your Micro-scale Body Sensors*, FORBES (Apr. 17, 2013), http://www.forbes.com/sites/singularity/2013/04/17/ingestible-implantable-or-intimate-contact-how-will-you-take-your-micro-scale-body-sensors; Martyn Landi, *Wearable Tech to Evolve Inside the Human Body*, IRISH EXAMINER, Mar. 20, 2014, *available at* http://www.irishexaminer.com/world/wearable-tech-to-evolve-inside-the-human-body-262624.html; Tom Abate, *Stanford Engineer Invents Safe Way to Transfer Energy to Medical Chips in the Body*, STANFORD NEWS (May 19, 2014), http://news.stanford.edu/news/2014/may/electronic-wireless-transfer-051914.html.
[128] Gary Marcus & Christof Koch, *The Future of Brain Implants*, WALL ST. J., Mar. 14, 2014, *available at* http://online.wsj.com/news/articles/SB10001424052702304914904579435592981780528.
[129] Michael Behar, *Can the Nervous System Be Hacked*? N.Y. TIMES MAG., May 23, 2014, *available at* http://www.nytimes.com/2014/05/25/magazine/can-the-nervous-system-be-hacked.html?partner=rssnyt&emc=rss.

batteries and update its software, patients and physicians will use an iPad app to control a wearable collar that transmits power and data wirelessly through the skin," the story noted.[130] The firm's goal is to use "bioelectronics" to "get the nervous system to tell the body to heal itself."[131] Meanwhile, a variety of firms and university research centers are experimenting with neural interfaces and bionic prosthetics to help individuals overcome various physical disabilities or simply enhance other human functions.[132]

- PillCam Colon, recently featured in the *Wall Street Journal*, has created "a capsule the size of a large vitamin [that] travels through a patient's digestive system over the course of several hours, wirelessly transmitting video images to an external data recorder."[133] As the *Journal* noted, this technology means that "colon-cancer screening may soon become less invasive, more accurate—and more prevalent."[134] The FDA approved the device in February 2014 for patients who have received incomplete colonoscopies.[135]
- MicroCHIPS has created a contraceptive implant that can be wirelessly controlled by women without having to make a trip to a clinic, but doctors would be able to adjust dosages remotely if the patient so requested.[136]
- CardioMEMS HF System uses a wireless sensor, implanted in the pulmonary artery, to transmit health information to an external device, and "then [it] forwards the data to the

[130] *Id.*
[131] *Id.*
[132] Eliza Strickland, *We Will End Disability by Becoming Cyborgs*, IEEE SPECTRUM (May 27, 2014), http://spectrum.ieee.org/biomedical/bionics/we-will-end-disability-by-becoming-cyborgs.
[133] Joseph Walker, *New Ways to Screen for Colon Cancer*, WALL ST. J., June 8, 2014, *available at* http://online.wsj.com/articles/new-ways-to-screen-for-colon-cancer-1402063124.
[134] *Id.*
[135] *Id.*
[136] Gwen Kinkead, *A Contraceptive Implant with Remote Control*, MIT TECH. REV. (July 4, 2014), http://www.technologyreview.com/news/528121/a-contraceptive-implant-with-remote-control.

patient's medical team."[137] It "is designed to reduce hospitalizations among patients with moderate heart failure by enabling physicians to identify problems and modify treatment before patients end up in the [emergency room]."[138]

- Proteus Digital Health has created an ingestible sensor no bigger than a grain of sand that "it hopes will increase the effectiveness of existing medications by helping to ensure they're taken as prescribed."[139] Users would swallow the pill while administering other medications. After it is activated by stomach fluids, the pill transmits relevant information to a small disposable body patch as well as to the patient's computing devices via a Bluetooth connection. That information can then be shared with medical professionals "to better understand how patients are responding to their treatments."[140]

Importantly, many of these implantable and ingestible innovations will be driven not just by commercial vendors, but also by average citizens working together to enhance various human capabilities.[141] Amateur "body hacking" or "biohacking" efforts will likely grow more prevalent in coming years.[142] Collaborative forums where individuals can share information and collaborate on various projects of this sort, such as Biohack.Me,[143] already exist.[144] Advocates of such amateur biohacking sometimes refer to themselves as "grinders," which Ben Popper of *The*

---

[137] Maria K. Rega, *Implantable Med Devices: 3 Smart Technologies to Watch*, PTC PRODUCT LIFECYCLE STORIES (June 2, 2014), http://blogs.ptc.com/2014/06/02/implantable-med-devices-3-smart-technologies-to-watch.
[138] *Id.*
[139] *Id.*
[140] *Id.*
[141] Glen Martin, *"Biohackers" Mining Their Own Bodies' Data*, SF GATE (June 28, 2012), http://www.sfgate.com /health/article/Biohackers-mining-their-own-bodies-data-3668230.php; Jim McLauchlin, *The Future of Bionic Humans: What's Next in Bio-Hacking?*, LIVESCIENCE (June 18, 2013), http://www.livescience.com/37507 -biohacking-james-rollins.html.
[142] Carolyn Y. Johnson, *As Synthetic Biology Becomes Affordable, Amateur Labs Thrive*, BOSTON GLOBE, Sept. 16, 2008, *available at* http://tech.mit.edu/V128/N39/biohack.html.
[143] See the forum at http://discuss.biohack.me (last visited Oct. 30, 2014).
[144] Keiron Monks, *Forget Wearable Tech: Embeddable Implants Are Already Here*, CNN (Apr. 8, 2014), http://www.cnn.com/2014/04/08/tech/forget-wearable-tech-embeddable-implants/.

Verge defines as "homebrew biohackers [who are] obsessed with the idea of human enhancement [and] who are looking for new ways to put machines into their bodies."[145]

As these technologies and capabilities advance, they will raise thorny ethical and legal issues. Ethically, they will raise questions of what it means to be human and the limits of what people should be allowed to do to their own bodies.[146] In the field of law, they will challenge existing health and safety regulations imposed by the FDA and other government agencies.

However, efforts to restrict such activities could be complicated by both practical and legal factors. Practically speaking, if enough people are attempting to modify their bodies or enhance various human capabilities, it may become very difficult for the law to keep up. Also—in terms of the law—because many of these activities will be of a voluntary, noncommercial nature, those producing and sharing information about biohacking activities will likely have First Amendment protection to do so, thereby making regulatory efforts even more challenging. Hence, regulators might have to focus on limiting the supply of materials and devices used by biohackers to achieve these goals. But those materials will likely fall in cost and expand in availability over time, especially with the rise of 3-D printing.[147] The FDA held a public workshop on these issues in early October 2014.[148]

A more robust discussion of biohacking—and the various policy issues it might raise—is beyond the scope of this paper. The debate over wearable technologies, however, could

---

[145] Ben Popper, *Cyborg America: Inside the Strange New World of Basement Body Hackers*, VERGE (Aug. 8, 2012), http://www.theverge.com/2012/8/8/3177438/cyborg-america-biohackers-grinders-body-hackers.

[146] For an overview of the differing opinions about how these technologies may affect our humanity, *see* JOEL GARREAU, RADICAL EVOLUTION: THE PROMISE AND PERIL OF ENHANCING OUR MINDS, OUR BODIES—AND WHAT IT MEANS TO BE HUMAN (2005).

[147] Dan Carsen, *With 3-D Printing, Affordable Prosthetics Are in Reach*, NPR (Mar. 13, 2014), http://www.npr.org/2014/03/13/289836980/with-3-d-printing-affordable-prosthetics-are-in-reach.

[148] Food and Drug Administration, *Additive Manufacturing of Medical Devices: An Interactive Discussion on the Technical Considerations of 3-D Printing; Public Workshop; Request for Comments*, 79 FED. REG. 96 (May 19, 2014), *available at* https://www.federalregister.gov/articles/2014/05/19/2014-11513/additive-manufacturing-of-medical-devices-an-interactive-discussion-on-the-technical-considerations.

foreshadow many of the same concerns and policy issues that will arise in these future debates. Moreover, some of the solutions that might emerge to deal with concerns about wearables might be useful when the debate over biohacking intensifies, which is why the issue has been discussed in this paper.

At a minimum, these technologies will force a conversation about how much control people have over their bodies or at least about information regarding their bodies. "Studies show that more-engaged patients have lower costs and better health outcomes," a recent *Wall Street Journal* report noted.[149] "Becoming familiar with one's own health records can help patients better understand their own condition and have more informed conversations with doctors."[150] But it remains to be seen whether such innovations will be allowed or how they might be regulated.

III. Which Policy Vision Will Govern the Internet of Things and Wearable Technology?

Many IoT technologies will be overhyped and could eventually fail.[151] For example, Internet-enabled refrigerators get plenty of attention today, but "the reality is that the average consumer

[149] Laura Landro, *The Health-Care Industry Is Pushing Patients to Help Themselves*, WALL ST. J., June 8, 2014, *available at* http://online.wsj.com/articles/the-health-care-industry-is-pushing-patients-to-help-themselves-1402065145.

[150] *Id.*

[151] Charles Arthur, *Wearables: One-Third of Consumers Abandoning Devices*, GUARDIAN, Apr. 1, 2014, available at http://www.theguardian.com/technology/2014/apr/01/wearables-consumers-abandoning-devices-galaxy-gear; Pascal-Emmanuel Gobry, *Today's Wearables Are an Overhyped Fad, but Wait a Few Years*, CITEWORLD (Mar. 20, 2014), http://www.citeworld.com/consumerization/23142/wearables-overhyped-fad; Zoë Corbyn, *Google Glass: Wearable Tech, but Would You Wear It?*, GUARDIAN, Apr. 5, 2014, available at http://www.theguardian.com/technology/2014/apr/06/google-glass-technology-smart-eyewear-camera-privacy; Duncan McKean, *Wearisome Wearables: Lessons Learned from a BMX Experiment, and Why Some Sections of Media Are Still Taking the Easy Option*, CCGROUP (Mar. 5, 2014), http://www.ccgrouppr.com/insights/blog/mobile/wearisome-wearables-lessons-learned-bmx-experiment-sections-media-still-taking-easy-option.

will replace his or her fridge no more than once per decade—and, most likely, not for improved functionality, just to keep the milk cold."[152]

As they become more commonplace and fashionable,[153] however, many other IoT technologies will succeed, including technologies and applications that are unimaginable today—albeit in a sporadic, unpredictable fashion.[154] Whether such technologies succeed or fail should be left to the interaction of inventors and consumers. What sort of policy regime will govern this fast-moving, constantly evolving space and help incentivize constantly expanding innovation and consumer choice? This paper will turn to that question next.

Wearable technology, like IoT more generally, raises a wide variety of potential concerns, many of which relate to privacy and security.[155] These social and cultural concerns will be the primary focus of this paper. Economic concerns—including worries about job dislocations because of increasing automation[156]—also will come up in discussions about some of these technologies, but they will not be the primary focus of this paper.

Such concerns are leading to a replay of a debate that has already occurred many times in the modern information economy: the clash between the "permissionless innovation" and "precautionary principle" mindsets. A recent book published by the Mercatus Center discussed the interplay between these two worldviews and the implications of this policy battle for the

---

[152] Collins et al., *supra* note 26, at 3.
[153] ROSE, *supra* note 17, at 28 ("The adoption of wearable devices will be accelerated at technology blends with fashion.").
[154] DuBravac, *supra* note 27, at 8 ("While some of these things might seem far off, their foundations are already unfolding before us. We tend to think about linearly moving from point A to point B, but that is not the process through which tech adoption and innovation diffusion typically occur. These advancements—the little steps for man and the big steps for mankind—tend to occur through a series of hybrid periods.").
[155] John Brandon, *Wearable Devices Pose Threats to Privacy and Security*, FOX NEWS (June 18, 2014), http://www.foxnews.com/tech/2014/06/18/wearable-devices-pose-threats-to-privacy-and-security; Raj Samani, *The IoT Is Already Here: Will You Be Secure?*, INFORMATION SECURITY BUZZ (Feb. 27, 2014), http://mcaf.ee/h2xom; Kashmir Hill, *The Half-Baked Security of Our "Internet of Things*,*"* FORBES (May 27, 2014), http://www.forbes.com/sites/kashmirhill/2014/05/27/article-may-scare-you-away-from-internet-of-things.
[156] NICHOLAS CARR, THE GLASS CAGE: AUTOMATION AND US (2014); Michael Sacasas, *It's Alive, It's Alive!*, FRAILEST THING (June 6, 2014), http://thefrailestthing.com/2014/06/06/its-alive-its-alive.

future of various emerging technologies.[157] Each of these policy visions will be summarized below, and then their applicability to the debate over wearables and IoT will be discussed.

A. Permissionless Innovation vs. the Precautionary Principle

Should the creators of new technologies seek the blessing of public officials before they develop and deploy their innovations? How people answer this question—which they might think of as "the permission question"—depends on the disposition they adopt toward new inventions.

One policy disposition is known as the *precautionary principle*. Generally speaking, it refers to the belief that new innovations should be curtailed or disallowed until their developers can prove that they will not cause any harms to individuals, groups, specific entities, cultural norms, or various existing laws, norms, or traditions.[158] Advocates believe policymakers should regulate new technology "early and often" to "get ahead of it" and address social and economic concerns preemptively.[159]

The other policy vision can be labeled *permissionless innovation*. The term refers to the notion that experimentation with new technologies and business models should generally be permitted by default. Unless a compelling case can be made that a new invention will bring serious harm to individuals, innovation should be allowed to continue unabated, and problems—if they develop at all—can be addressed later.[160] Permissionless innovation is not an absolutist position that denies any role for government. Rather, it is an aspirational goal that stresses the benefit of pushing "innovation allowed" as the best default position to begin debates about

---

[157] THIERER, *supra* note 7.
[158] *Id.* at vii.
[159] John Frank Weaver, *We Need to Pass Legislation on Artificial Intelligence Early and Often*, SLATE FUTURE TENSE (Sept. 12, 2014), http://www.slate.com/blogs/future_tense/2014/09/12/we_need_to_pass_artificial_intelligence_laws_early_and_often.html.
[160] *Id.*

technology policy. The burden of proof is on those who favor preemptive, precautionary controls to explain why ongoing trial-and-error experimentation with new technologies or business models should be disallowed.

The clash between these two visions is already evident in today's policy discussions regarding wearable and IoT technologies. Again, some already worry about the security[161] and privacy implications of a world of wearable technology.[162] Others worry about the overquantification of people's lives[163] or—more profoundly—that these technologies will turn people into robots[164] or "cyborgs."[165]

Some of these fears are likely driven by the rapid evolution of technologies in this space.[166] The most notable wearable technology on the market today—and among the most controversial—is Google Glass.[167] The peer-to-peer surveillance capabilities of Google Glass and other wearables—such as the Narrative clip-on camera, which allows users to automatically take

---

[161] *Home, Hacked Home*, ECONOMIST, July 12, 2014, *available at* http://www.economist.com/news/special-report/21606420-perils-connected-devices-home-hacked-home.

[162] Hayley Tsukayama, *Wearable Tech Such as Google Glass, Galaxy Gear Raises Alarms for Privacy Advocates*, WASH. POST, Sept. 30, 2013, *available at* http://www.washingtonpost.com/business/technology/wearable-technology-raise-privacy-concerns/2013/09/30/0a81a960-2493-11e3-ad0d-b7c8d2a594b9_story.html.

[163] Brendan O'Connor, *When Quantified-Self Apps Leave You with More Questions Than Answers*, DAILY DOT (Feb. 27, 2014), http://www.dailydot.com/technology/reporter-quantified-self-app; Ben Williamson, *Calculating the Child Through Technologies of the 'Quantified Self,'* DMLCENTRAL (May 26, 2014), http://dmlcentral.net/blog/ben-williamson/calculating-child-through-technologies-%E2%80%98quantified-self%E2%80%99.

[164] Evan Selinger, *Google vs. Our Humanity: How the Emerging 'Internet of Things' Is Turning Us into Robots*, SALON (May 22, 2014), http://www.salon.com/2014/05/22/google_vs_our_humanity_how_the_emerging_internet_of_things_is_turning_us_into_robots.

[165] Cyrus Farivar, *"Stop the Cyborgs" Launches Public Campaign Against Google Glass*, ARS TECHNICA (Mar. 22, 2013), http://arstechnica.com/tech-policy/2013/03/stop-the-cyborgs-launches-public-campaign-against-google-glass; Dann Berg, *Will Google Glasses Make Us Cyborgs?*, LAPTOP (Nov. 19, 2012), http://blog.laptopmag.com/will-google-glasses-make-us-cyborgs; John Danaher, *Is Modern Technology Creating a Borg-Like Society?*, REAL CLEAR TECHNOLOGY (June 11, 2014), http://www.realcleartechnology.com/articles/2014/06/11/is_modern_technology_creating_a_borg-like_society_1184.html.

[166] *See* Amy Collins, Adam J. Fleisher, D. Reed Freeman, Jr. & Alistair Maughan, *The Internet of Things Part 2: The Old Problem Squared*, CLIENT ALERT (Morrison Foerster), Mar. 20, 2014, at 6, *available at* http://media.mofo.com/files/Uploads/Images/140320-The-Internet-of-Things-Part-2.pdf (raising the question "whether the regulators can work fast enough to keep up with what the technology is capable of doing").

[167] Clive Thompson, *Googling Yourself Takes on a Whole New Meaning*, N.Y. TIMES, Aug. 30, 2013, *available at* http://mobile.nytimes.com/2013/09/01/magazine/googling-yourself-takes-on-a-whole-new-meaning.html?pagewanted=5&_r=0&hpw=&.

snapshots of their daily activities every 30 seconds—have already spawned a variety of privacy fears.[168] Other forms of wearable microphotography are coming to market just now (see, e.g., Butterfleye,[169] Autographer,[170] and CA7CH Lightbox[171]). They will eventually allow users to snap pictures at regular intervals but soon will likely also enable real-time audio and video streaming.[172] Of course, many other wearable cameras (e.g., GoPro) have been on the market for years, but the quality of those technologies is now rising as rapidly as their size and cost are falling.[173]

Such real-time "life-logging" tools and activities raise a variety of privacy concerns.[174] In particular, how much data will these devices collect about users, how long will the data be retained, and who else might have access to that information?[175] The answers to these questions remain unclear at this point, but it is equally unclear what sort of beneficial uses and applications might flow from such technologies.[176] Those beneficial uses are often only discovered after a great deal of experimentation.

---

[168] Liz Gannes, *Narrative: Formerly Known as Memoto—Launches Life-Logging Camera, Raises $3M*, ALL THINGS D (Oct. 3, 2013), http://allthingsd.com/20131003/narrative-formerly-known-as-memoto-launches-life-logging-camera-raises-3m.

[169] *An Intelligent, Sneaky, Wireless Camera for the Ultra-Connected Home*, CNET (May 21, 2014), http://www.cnet.com/products/butterfleye.

[170] Hugh Langley, *Autographer Boss: Google Glass Privacy Fears Have Been Exaggerated by the Media,* TECH RADAR (June 18, 2014), http://www.techradar.com/news/photography-video-capture/google-glass-privacy-fears-have-been-exaggerated-by-the-media-says-autographer-creator-1253837.

[171] Edgar Cervantes, *CA7CH Lightbox: The Next Wearable Camera to Compete Against the GoPro*, ANDROID AUTHORITY (June 18, 2014), http://www.androidauthority.com/ca7ch-lightbox-wearable-camera-394812.

[172] E. J. Dickson, *Google Glass Livestream Brings Your Privacy Nightmares to Life*, DAILY DOT (Apr. 8, 2014), http://www.dailydot.com/technology/google-glass-livestream.

[173] Alyssa Bereznak, *Panasonic's New Head-Mounted 4K Camera Will Capture Your Adventures More Clearly Than Ever*, YAHOO TECH (Mar. 24, 2014), https://www.yahoo.com/tech/panasonics-new-head-mounted-4k-camera-will-capture-80589689809.html.

[174] Heather Kelly, *Google Glass Users Fight Privacy Fears*, CNN (Dec. 12, 2013), http://www.cnn.com/2013/12/10/tech/mobile/negative-google-glass-reactions.

[175] Jamie Carter, *Wearable Cameras Are All the Rage, but Should We All Become Lifeloggers?*, TECH RADAR (June 4, 2014), http://www.techradar.com/us/news/world-of-tech/life-through-a-lens-trials-and-tribulations-of-a-life-logger-1251717?src=rss&attr=all.

[176] *Every Step You Take*, ECONOMIST, Nov. 16, 2013, *available at* http://www.economist.com/news/leaders/21589862-cameras-become-ubiquitous-and-able-identify-people-more-safeguards-privacy-will-be.

Nonetheless, some policymakers, academics, and regulatory activists are calling for policy action on the potential privacy and security vulnerabilities associated with IoT and wearable technologies.[177] In a new paper titled "Regulating the Internet of Things," University of Colorado Law School professor Scott R. Peppet says that mere potential for certain harms "suggests a need for urgency" on this front.[178] He continues,

> Not only are consumers currently vulnerable to the discrimination, privacy, security and consent problems outlined here, but it may become harder over time to address such issues. In technological and political circles it may be convenient to prescribe a "wait and see—let the market evolve" stance, but the reality is that as time passes it will likely become harder, not easier, for consumer advocates, regulators, and legislators to act. The Internet of Things is here. It would be wise to respond as quickly as possible to its inherent challenges.[179]

In other words, Peppet is suggesting that new innovation in this space should be preemptively curtailed, or at least tightly regulated, to ensure that none of these potential risks or harms develop. Again, this is precautionary principle thinking.

Some lawmakers and regulators have endorsed that sort of precautionary approach as the basis of public policy toward IoT and wearable technologies. Federal Trade Commission (FTC) Chairwoman Edith Ramirez addressed these issues in a 2013 speech, "The Privacy Challenges of Big Data: A View from the Lifeguard's Chair."[180] Ramirez worried about the privacy and security concerns associated with "big data," or the massive datasets of information made available through various modern digital sites and services. Ramirez claimed,

> The indiscriminate collection of data violates the First Commandment of data hygiene: Thou shall not collect and hold onto personal information unnecessary to an identified

---

[177] Bruce Schneier, *Will Giving the Internet Eyes and Ears Mean the End of Privacy?*, GUARDIAN, May 16, 2013, *available at* http://www.guardian.co.uk/technology/2013/may/16/internet-of-things-privacy-google; Mike Wheatley, *Big Brother's Big Data: Why We Must Fear the Internet of Things*, SILICON ANGLE (Jan. 10, 2013), http://silicon angle.com/blog/2013/01/10/big-brothers-big-data-why-we-must-fear-the-internet-of-things.
[178] Peppet, *supra* note 4, at 71.
[179] *Id.*
[180] Edith Ramirez, Chairwoman, Fed. Trade Comm'n, Keynote Address at the Technology Policy Institute Aspen Forum (Aug. 19, 2013), *available at* http://www.ftc.gov/speeches/ramirez/130819bigdataaspen.pdf.

> purpose. Keeping data on the off chance that it might prove useful is not consistent with privacy best practices. And remember, not all data is created equally. Just as there is low quality iron ore and coal, there is low quality, unreliable data. And old data is of little value.[181]

Thus, she claimed, "information that is not collected in the first place can't be misused," and then she outlined a parade of "horribles" that will occur if such data collection is allowed at all.[182] She was particularly concerned that companies might use such data to discriminate against certain classes of customers.

There are other concerns regarding data collection practices. Some legal scholars today decry what Ryan Calo of the University of Washington School of Law calls "digital market manipulation," or the belief that "firms will increasingly be able to trigger irrationality or vulnerability in consumers—leading to actual and perceived harms that challenge the limits of consumer protection law, but which regulators can scarcely ignore."[183] Others fear "power asymmetries" between companies and consumers and even suggest that consumers' apparent lack of concern about sharing information means that people may not be acting in their own best self-interest when it comes to online safety and digital privacy choices.[184] "We could imagine," Calo suggests, "the government fashioning a rule—perhaps inadvisable for other reasons—that

---

[181] *Id.* at 4.
[182] *Id.* at 6.
[183] Ryan Calo, *Digital Market Manipulation*, 42 GEO. WASH. L. REV. 995 (2014), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2309703. *See also* David Talbot, *Data Discrimination Means the Poor May Experience a Different Internet*, MIT TECH. REV. (Oct. 9, 2013), http://www.technologyreview.com/news/520131/data-discrimination-means-the-poor-may-experience-a-different-internet.
[184] *See, e.g.*, Anita L. Allen, *Coercing Privacy*, 40 WM. & MARY L. REV. 723 (1999). *See also* Mark MacCarthy, *New Directions in Privacy: Disclosure, Unfairness, and Externalities*, 6 I/S: J. L. & POL'Y INFO. SOC'Y 425, 443 (2011) ("The idea is that individual choice in this area would lead, in a piecemeal fashion, to the erosion of privacy protections that are the foundation of the democratic regime, which is the heart of our political system. Individuals are making an assessment—at least implicitly—of the advantages and disadvantages to them of sharing information. They are determining that information sharing is, on balance, a net gain for them. But the aggregate effect of these decisions is to erode the expectation of privacy and also the role of privacy in fostering self-development, personhood, and other values that underlie the liberal way of life. In this way, individual choices are not sufficient to justify information practices that collectively undermine widely shared public values" [footnote omitted].).

limits the collection of information about consumers in order to reduce asymmetries of information."[185]

B. The Problem with Precautionary Principle–Based Policymaking

So, what's wrong with this sort of precautionary approach to policymaking? Doesn't it make sense to plan ahead for worst-case scenarios, including those that might develop for IoT and wearable technologies? After all, these technologies clearly have the potential to disrupt well-established social and legal norms.

Anticipating and seeking to avoid potential hazards are important parts of life, but there are problems with converting the logic of "better safe than sorry" from an informal personal or institutional prescription into a formal legal directive. When individuals and institutions apply anticipatory, precautionary thinking and policies in their own lives or business decisions, they bear the cost of those efforts. By contrast, when precautionary thinking is converted into preemptive policy prescriptions, the cost of those actions will be borne by a far greater universe of actors.

Generally speaking, the problem with "precautionary" policymaking comes down to this: if people spend all their time living in constant fear of worst-case scenarios—and premising public policy on such fears—it means that best-case scenarios will never come about. Wisdom and progress are born from experience, including experiences that involve risk and the possibility of occasional mistakes and failures.[186] As the old adage goes, "nothing ventured, nothing gained."

---

[185] Calo, *supra* note 183, at 1035.
[186] THIERER, *supra* note 7, at viii.

More concretely, the problem with "permissioning" innovation is that traditional regulatory policies and systems tend to be overly rigid, bureaucratic, costly, and slow to adapt to new realities.[187] Policies and regulatory systems based on precautionary thinking focus on preemptive remedies that aim to predict the future and its hypothetical problems, which may not ever come about. Worse yet, preemptive bans or regulatory prescriptions can limit innovations that yield new and better ways of doing things.[188]

Regardless of whether the technical regulatory specifications for "permissioned" products and services are published in advance or whether firms must seek special permission before they offer a new product or service, both varieties of preemptive regulation have the same effect: they raise the cost of starting or running a business or nonbusiness venture and therefore discourage activities that benefit society. Such precautionary regulation can limit what Angela Benton, founder and CEO of NewME Accelerator, refers to as "democratized entrepreneurship," or the sort of modern start-up culture that means "just about anyone can afford to launch a business."[189] In turn, such limitation has implications for consumers and end users of technology. Overly prescriptive regulatory systems can raise the cost of goods and services, diminish the quality of those goods and services, or limit the range of choices that the public has at its disposal.[190] Thus, preemptive, precautionary constraints should generally be reserved for circumstances with immediate and extreme threat to safety, security, or privacy.

---

[187] ABELSON ET AL., *supra* note 8, at 285 ("Bureaucracies change more slowly than the technologies they regulate.").
[188] AARON WILDAVSKY, SEARCHING FOR SAFETY 183 (1988) ("Regulation, because it deals with the general rather than with the particular, necessarily results in forbidding some actions that might be beneficial. Regulators cannot devise specifications sufficiently broad to serve as guidelines for every contingency without also limiting some actions that might increase safety. Because regulation is anticipatory, regulators frequently guess wrong about which things are dangerous; therefore, they compensate by blanket prohibitions.")
[189] Angela Benton, *Angela Benton on the Future of Entrepreneurship*, WALL ST. J., July 7, 2014, *available at* http://online.wsj.com/articles/angela-benton-on-the-future-of-entrepreneurship-1404762819.
[190] THIERER, *supra* note 7, at viii.

Precautionary principle thinking is often discussed in the context of IoT. Recall, for example, Calo's hypothetical rule that "limits the collection of information about consumers in order to reduce asymmetries of information."[191] Although Calo does not endorse the adoption of such a rule at this time, the cost of such a rule and comparable regulatory proposals should be taken into account and subjected to a strict benefit-cost analysis.[192] Alleviating all "information asymmetries" would be impossible without sweeping and constant regulatory interventions. If such precautionary regulation were imposed on IoT technologies, it could stifle the provision of devices and services that could substantially improve consumer welfare.[193]

The same would likely be true if Chairwoman Ramirez's approach to a preemptive data use "commandment" were enshrined into a law that said, "Thou shall not collect and hold onto personal information unnecessary to an identified purpose."[194] Such a precautionary limitation would certainly satisfy her desire to avoid hypothetical worst-case outcomes because, as she noted, "information that is not collected in the first place can't be misused,"[195] but it is equally true that information that is never collected may never lead to serendipitous data discoveries or new products and services that could offer consumers concrete benefits. "The socially beneficial uses of data made possible by data analytics are often not immediately evident to data subjects at the time of data collection," notes Ken Wasch, president of the Software & Information Industry

---

[191] Calo, *supra* note 183, at 1035.
[192] Adam Thierer, *A Framework for Benefit-Cost Analysis in Digital Privacy Debates*, 20 GEO. MASON L. REV. 1055, 1066–69 (2013), *available at* http://www.georgemasonlawreview.org/doc/Thierer_Website.pdf; Future of Privacy Forum, cmt. to the Fed. Trade Comm'n on Internet of Things, Project No. P135405 (Jan. 10, 2014), at 13, *available at* http://www.ftc.gov/sites/default/files/documents/public_comments/2014/01/00013-88250.pdf ("The value of the Internet of Things will largely come from rapidly evolving, beneficial uses of data. When considering whether the use of data is appropriate to the context, consideration should instead be given to the likely benefits and the risk, if any, of actual harm.").
[193] *A Status Update on the Development of Voluntary Do-Not-Track Standards, United States Senate*, 113th Cong. 2–3 (Apr. 24, 2013) (testimony of Adam Thierer, Mercatus Center), *available at* http://mercatus.org/sites/default/files/Thierer_testimony_DNT_042313.pdf.
[194] Ramirez, *supra* note 180.
[195] *Id.*

Association.[196] If academics and lawmakers succeed in imposing such precautionary rules on the development of IoT and wearable technologies, many important innovations may never see the light of day.

C. The Importance of Regulatory Patience and Humility

An embrace of permissionless innovation over precautionary principle thinking requires that legislators and regulators understand that patience and humility are worth embracing as policy virtues.[197] To the maximum extent possible, policymakers should exercise restraint and resist the urge to try to plan the future and all the various scenarios—good or bad—that might come about. This policy can be labeled *forbearance*.

FTC Commissioner Maureen K. Ohlhausen concisely elucidated the philosophy of forbearance in an October 2013 speech, "The Internet of Things and the FTC: Does Innovation Require Intervention?," in which she noted that "the success of the Internet has in large part been driven by the freedom to experiment with different business models, the best of which have survived and thrived, even in the face of initial unfamiliarity and unease about the impact on consumers and competitors."[198]

Ohlhausen pointed out that the precautionary mindset is dangerous when enshrined into policy directives because regulators—in their zeal to correct for consumers' supposed irrationality or ignorance—often ignore regulators' irrationality or ignorance. In other words, regulators can spend so much time focused on the supposed irrationality of consumers and their

---

[196] Letter from Ken Wasch, President, Software & Info. Indus. Ass'n, to Edith Ramirez, Chairwoman, Fed. Trade Comm'n (May 31, 2013), at 6, *available at* http://www.siia.net/index.php?option=com_docman&task=doc_download&gid=4325&Itemid=318.

[197] *This section was adapted from* THIERER, *supra* note 7, at 34–35, 66.

[198] Maureen K. Ohlhausen, *The Internet of Things and the FTC: Does Innovation Require Intervention?*, Remarks Before the U.S. Chamber of Commerce (Oct. 18, 2013), http://www.ftc.gov/speeches/ohlhausen/131008internet thingsremarks.pdf.

openness to persuasion or manipulation that those regulators end up ignoring their own irrationality or ignorance. Regulators simply do not possess the requisite knowledge to perfectly plan for every conceivable outcome, and attempts to do so will likely have many unintended consequences.[199]

This is particularly true for information technology markets, which generally evolve much more rapidly than other sectors and especially more rapidly than the law itself.[200] Technology author Larry Downes notes that policymaking in the information age is inexorably governed by the "law of disruption" or the fact that "technology changes exponentially, but social, economic, and legal systems change incrementally."[201] This law is "a simple but unavoidable principle of modern life," he said, and it will have profound implications for the way businesses, government, and culture evolve. "As the gap between the old world and the new gets wider," he argues, "conflicts between social, economic, political, and legal systems" will intensify, and "nothing can stop the chaos that will follow."[202]

That insight prompts Ohlhausen to caution her fellow regulators:

> It is . . . vital that government officials, like myself, approach new technologies with a dose of regulatory humility, by working hard to educate ourselves and others about the innovation, understand its effects on consumers and the marketplace, identify benefits and likely harms, and, if harms do arise, consider whether existing laws and regulations are sufficient to address them, before assuming that new rules are required.[203]

---

[199] ABELSON ET AL., *supra* note 8, at 159 ("Too often, well-intentioned efforts to regulate technology are far worse than the imagined evils they were intended to prevent.").
[200] Collins et al., supra note 166, at 6 ("The key issue seems likely to be whether the regulators can work fast enough to keep up with what the technology is capable of doing.").
[201] LARRY DOWNES, THE LAWS OF DISRUPTION: HARNESSING THE NEW FORCES THAT GOVERN LIFE AND BUSINESS IN THE DIGITAL AGE 2 (2009).
[202] *Id.* at 2–3. In a similar sense, Andy Grove, former CEO of Intel, once reportedly said, "High tech runs three-times faster than normal businesses. And the government runs three-times slower than normal businesses. So we have a nine-times gap." Lillian Cunningham, *Google's Eric Schmidt Expounds on His Senate Testimony*, WASH. POST, Oct. 1, 2011, *available at* http://www.washingtonpost.com/national/on-leadership/googles-eric-schmidt-expounds-on-his-senate-testimony/2011/09/30/gIQAPyVgCL_story.html.
[203] Ohlhausen, *supra* note 198.

Compared to Chairwoman Ramirez's policy approach, which is clearly based on precautionary principle thinking rooted in fears about hypothetical worst-case outcomes, Ohlhausen's approach to technological innovation in this space is consistent with the permissionless innovation approach.

If policymakers care about expanding innovation opportunities, boosting consumer choice, and enhancing human welfare, then the philosophy of humility and forbearance should guide public policy. Policymakers should generally exercise restraint and resist the urge to try to plan the future and anticipate all the various scenarios—good or bad—that might come about.[204] Prospective regulation based on hypothesizing about future harms that may never materialize is likely to come at the expense of innovation and growth opportunities. To the extent that any corrective action is needed to address harms, ex post measures, especially via the common law, are typically superior.[205]

Another lesson flows from this observation: not every wise ethical principle, social norm, or industry best practice automatically makes wise public policy prescriptions.[206] If policymakers hope to preserve a free and open society, they must not convert every ethical directive or societal norm—no matter how sensible—into a legal directive.

For these reasons, more flexible, bottom-up approaches to solving complex problems are almost always superior to preemptive, precautionary, top-down controls. A variety of these less burdensome bottom-up solutions will be outlined in section VI.

That being said, IoT and wearable technologies will raise many legitimate issues that deserve to be taken seriously and addressed in a constructive fashion. Some of these concerns,

---

[204] THIERER, *supra* note 7, at viii.
[205] Adam Thierer, *Why Permissionless Innovation Matters*, MEDIUM (Apr. 24, 2014), https://medium.com /challenging-the-status-quo/why-permissionless-innovation-matters-257e3d605b63.
[206] THIERER, *supra* note 7, at viii.

such as the safety of medical apps and wearable health devices, may raise some serious issues that deserve regulatory scrutiny. Such safety concerns will likely relate to only a subset of IoT devices, however. Privacy-related concerns will likely apply to a much wider class of IoT and wearable technologies, which is why those issues receive more attention in this paper. As will be noted next, traditional privacy regulatory paradigms and policies are likely to be unequipped to deal with some of these concerns.

IV. How the Internet of Things Challenges Traditional Privacy Norms and Legal Standards

Because of the massive amount of information that IoT and wearable technologies can gather, privacy- and security-related concerns will grow as these devices and services proliferate.[207] Users enjoy the personalization and customization that IoT and wearable technologies offer, yet those same capabilities that are so hotly demanded also exacerbate digital privacy and data security risks that already existed for traditional online services and technologies.[208] These privacy- and security-related concerns can arise with regard to access to the device itself (i.e., what happens if it is lost or stolen); access to the information the device shares with nearby devices or systems (i.e., information shared over Wi-Fi or other wireless systems); or access to information transmitted to the cloud or to any remote storage system.[209]

---

[207] Patrick Thibodeau, *The Internet of Things Could Encroach on Personal Privacy*, COMPUTERWORLD (May 3, 2014), http://www.computerworld.com/s/article/9248086/The_Internet_of_Things_could_encroach_on_personal_privacy; Jaikumar Vijayan, *The Internet of Things Likely to Drive an Upheaval for Security*, COMPUTERWORLD (May 2, 2014), http://www.computerworld.com/s/article/9248069/The_Internet_of_Things_likely_to_drive_an_upheaval_for_security.

[208] Jat Singh & Julia Powles, *The Internet of Things: The Next Big Challenge to Our Privacy*, GUARDIAN, July 28, 2014, *available at* http://www.theguardian.com/technology/2014/jul/28/internet-of-things-privacy; Alexander Suarez, *Wearable Fitness Device Privacy Concerns Abound*, JDSUPRA (Sept. 11, 2014), http://www.jdsupra.com/legalnews/wearable-fitness-device-privacy-concerns-17278.

[209] Al Sacco, *Fitness Trackers Are Changing Online Privacy: And It's Time to Pay Attention*, CIO (Aug. 14, 2014), http://www.cio.com/article/2465142/wearable-technology/fitness-trackers-are-changing-online-privacy-and-its-time-to-pay-attention.html.

This section will specifically explore how IoT technologies in general and wearables in particular challenge traditional privacy norms—both social and legal—and will explain why a more creative and flexible approach to dealing with these issues will be necessary. It is important that the privacy concerns regarding wearable technologies relate to both the users of those technologies and others in surrounding environments. For users, the privacy concern is that wearables allow a massive amount of data to be observed, gathered, and shared about them—potentially without their knowledge.[210] Moreover, such data can be very sensitive—particularly the information related to their health or specific medical conditions.[211] In turn, these new datasets might be used by third parties for marketing purposes, by employers for job-related purposes, or even by insurers to adjust user premiums. This possibility raises the specter of IoT and wearable devices and the datasets they generate being used in a supposedly discriminatory fashion.

There are also concerns for those in environments where others are using wearable technologies. Such individuals may not be able to control how the wearable technologies used by others might be capturing their actions or data, and it may prove difficult if not impossible for them to grant consent in such contexts.[212]

---

[210] Article 29 Data Protection Working Party, *Opinion 8/2014 on the Recent Developments on the Internet of Things*, No. 14/EN WP 223 (Sept. 16, 2014), at 4, *available at* http://ec.europa.eu/justice/data-protection/article-29/documentation/opinion-recommendation/files/2014/wp223_en.pdf ("[O]nce the data is remotely stored, it may be shared with other parties, sometimes without the individual concerned being aware of it. In these cases, the further transmission of his/her data is thus imposed on the user who cannot prevent it without disabling most of the functionalities of the device. As a result of this chain of actions, the IoT can put device manufacturers and their commercial partners in a position to build or have access to very detailed user profiles.").

[211] *Id.* (quoting Kevin Haley, Director of Symantec's Security Response team) ("It's the nature of the data that's being collected. This is really getting to the essence of our being. It's hard to believe people are willing to share all this stuff, especially around health.").

[212] Article 29 Data Protection Working Party, *supra* note 210, at 7 ("[C]lassical mechanisms used to obtain individuals' consent may be difficult to apply in the IoT, resulting in a 'low-quality' consent based in a lack of information or in the factual impossibility to provide fine-tuned consent in line with the preferences expressed by individuals.").

A. Growing Privacy-Related Regulatory Interest in IoT and Wearables

Policymaker interest in IoT and wearable technology is growing, and getting the legislative and regulatory balance right will affect the potential for ongoing innovation in this arena. "Courts, regulators, and lawmakers will be fighting over IoT privacy safeguards for years to come," notes Patrick Thibodeau of *Computerworld*.[213] In fact, that process has already begun.

In April 2013, the FTC launched an inquiry into the "Privacy and Security Implications of the Internet of Things" and invited comments.[214] That proceeding was followed by a daylong workshop on November 21, 2013, in Washington, DC.[215] In May 2014, the White House also completed an expedited ninety-day study "to examine how big data will transform the way we live and work and alter the relationships between government, citizens, businesses, and consumers."[216]

Shortly thereafter, on May 7, 2014, the FTC also hosted a seminar, "Consumer Generated and Controlled Health Data," which explored the privacy concerns surrounding website and digital applications (including wearables) that collect information about personal health and fitness.[217] Following the FDA's draft guidance for mobile medical applications, which was discussed earlier, this FTC effort may become the federal government's next major foray into IoT and wearable technology regulation,[218] especially because many privacy advocates are

---

[213] Thibodeau, *supra* note 40.
[214] Press Release Fed. Trade Comm'n, FTC Seeks Input on Privacy and Security Implications of the Internet of Things (Apr. 17, 2013), *available at* http://www.ftc.gov/news-events/press-releases/2013/04/ftc-seeks-input-privacy-and-security-implications-internet-things.
[215] Fed. Trade Comm'n, *Internet of Things: Privacy and Security in a Connected World* (Nov. 19, 2013), http://www.ftc.gov/news-events/events-calendar/2013/11/internet-things-privacy-security-connected-world.
[216] EXEC. OFFICE OF THE PRESIDENT, BIG DATA: SEIZING OPPORTUNITIES, PRESERVING VALUES (May 2014), *available at* http://www.whitehouse.gov/sites/default/files/docs/big_data_privacy_report_may_1_2014.pdf.
[217] Fed. Trade Comm'n, *Spring Privacy Series: Consumer Generated and Controlled Health Data* (May 7, 2014), http://www.ftc.gov/news-events/events-calendar/2014/05/spring-privacy-series-consumer-generated-controlled-health-data.
[218] Mark Sullivan, *FTC May Soon Turn Its Regulatory Gaze Toward Data-Collecting Health Apps*, VENTUREBEAT (May 16, 2014), http://venturebeat.com/2014/05/16/ftc-may-soon-turn-its-regulatory-gaze-toward-data-collecting-health-apps.

already clamoring for policy action on this front.[219] This move is happening against the backdrop of broader privacy-related policy efforts. Federal and state lawmakers have introduced a variety of privacy-related measures in recent years,[220] and regulatory interest in IoT and wearable technology is growing in Europe[221] and Asia.[222]

B. IoT and the Fair Information Practice Principles

What these efforts share is a desire to extend traditional privacy norms and protections to the world of "big data" and IoT. With more information being produced, collected, categorized, and repurposed than ever before, policymakers worry that new laws and preemptive regulations may be needed to head off potential worst-case scenarios.[223]

Generally, these efforts have focused on translating traditional fair information practice principles (FIPPs) into a workable set of industry best practices. Modern privacy law and policy have been driven by a focus on these FIPPs and how they might guide data collection and use.[224] Obama administration privacy reports have generally listed the following FIPPs: Individual

---

[219] Andrea Peterson, *Privacy Advocates Warn of 'Nightmare' Scenario as Tech Giants Consider Fitness Tracking*, WASH. POST, May 19, 2014, *available at* http://www.washingtonpost.com/blogs/the-switch/wp/2014/05/19/privacy-advocates-warn-of-nightmare-scenario-as-tech-giants-consider-fitness-tracking; LINDA ACKERMAN, *Mobile Health and Fitness Applications and Information Privacy Report to California Consumer Protection Foundation* (July 15, 2013), *available at* https://www.privacyrights.org/mobile-medical-apps-privacy-consumer-report.pdf.

[220] Padro Pavon, *The "Internet of Things" Will Impact Law and Regulation in 2014*, INFORMATION SECURITY REVIEW (Jan. 15, 2014), http://infosecreview.com/2014/01/15/the-internet-of-things-will-impact-law-and-regulation-in-2014.

[221] Helen Rebecca Schindler, Jonathan Cave, Neil Robinson, Veronika Horvath, Petal Hackett, Salil Gunashekar, Maarten Botterman, Simon Forge & Hans Graux, *Europe's Policy Options for a Dynamic and Trustworthy Development of the Internet of Things* (SMART 2012/0053, 2013), *available at* http://www.rand.org/pubs/research_reports/RR356.html; *New Guidelines on Data Ownership and Liability Could Be Issued to Address 'Internet of Things' Phenomenon*, OUT-LAW (July 4, 2014), http://www.out-law.com/en/articles/2014/july/new-guidelines-on-data-ownership-and-liability-could-be-issued-to-address-internet-of-things-phenomenon.

[222] Chris Neiger, *China Is Dominating the Internet of Things*, MOTLEY FOOL (June 15, 2014), http://www.fool.com/investing/general/2014/06/15/china-is-dominating-the-internet-of-things.aspx.

[223] Kate Tummarello, *Obama's 'Big Data' Report Calls for New Privacy Laws*, HILL (May 1, 2014), http://thehill.com/policy/technology/204961-white-house-big-data-report-calls-for-new-privacy-laws.

[224] Robert Gellman, *Fair Information Practices: A Basic History* (Apr. 4, 2014) (unpublished manuscript, Version 2.12), http://bobgellman.com/rg-docs/rg-FIPShistory.pdf (last visited Nov. 3, 2014).

Control (i.e., "notice and consent"), Transparency, Respect for Context, Security, Access, Accuracy, Focused Collection, and Accountability.[225] The administration has advocated that such principles govern private-sector data collection and use and that they be formally enshrined in a congressionally implemented Consumer Privacy Bill of Rights.[226] Congress has not yet acted on the administration's request, however.

That may be because lawmakers understand the challenge of applying FIPPs in a strict, legalistic fashion considering how rapidly technology, business practices, and consumer demands are evolving in the modern economy.[227] The lack of policy action may also be due to a more fundamental problem that has long haunted privacy policy and enforcement: definitional confusion.[228] Writing at the International Association of Privacy Professionals blog, Brooks Dobbs, chief privacy officer for KBM Group, notes that "the terms 'personal data,' 'personal information,' and 'personally identifiable information' are often used interchangeably, [but] it's apparent they could easily be read to speak to fundamentally different things." He notes that this is

> an enormous problem at the heart of our profession. Simply stated, as privacy professionals, we generally believe our jobs revolve around maintaining controls for the appropriate use and disclosure of either PII or personal data, but we can't agree on what those terms mean . . . . This definitional problem is leading to monumental uncertainty at the core of our profession.[229]

---

[225] Exec. Office of the President, *supra* note 216, at 19–20.
[226] WHITE HOUSE, CONSUMER DATA PRIVACY IN A NETWORKED WORLD: A FRAMEWORK FOR PROTECTING PRIVACY AND PROMOTING INNOVATION IN THE GLOBAL DIGITAL ECONOMY (Feb. 2012), http://www.whitehouse.gov/sites /default/files/privacy-final.pdf.
[227] Jane Yakowitz Bambauer, *The New Intrusion*, 88 NOTRE DAME L. REV. 205, 274 (2012), http://papers.ssrn.com /sol3/papers.cfm?abstract_id=2019079 ("To this point, American lawmakers have been wisely reluctant to condemn the accumulation of personal information until we fully understand its consequences.").
[228] *See* Adam Thierer, *The Pursuit of Privacy in a World Where Information Control Is Failing*, 36 HARV. J.L. & PUB. Pol'y 409, 424–35 (2013) ("[P]rivacy has always been a highly subjective philosophical concept. It is also a constantly morphing notion that evolves as societal attitudes adjust to new cultural and technological realities. For these reasons, America may never be able to achieve a coherent fixed definition of the term or determine when it constitutes a formal right outside of some narrow contexts.").
[229] Brooks Dobbs, *The Problem at the Heart of the Privacy Profession*, PRIVACY PERSPECTIVES (May 19, 2014), https://www.privacyassociation.org/privacy_perspectives/post/the_problem_at_the_heart_of_the_privacy_profession.

Moreover, each of the core FIPPs is open to extensive interpretational disagreements among policymakers and privacy professionals alike. Brookings Institution scholars Benjamin Wittes and Wells C. Bennett conclude that privacy is "something of an intellectual rabbit hole, a notion so contested and ill-defined that it often offers little guidance to policymakers concerning the uses of personal information they should encourage, discourage, or forbid."[230]

But these definitional dilemmas are only part of the problem. Even if "privacy" and the corresponding FIPPs could be defined with greater academic and legal rigor, an equally thorny problem arises when determining how to translate these principles into a workable enforcement regime for IoT and wearable technology. First Amendment–related hurdles to privacy enforcement may also exist. Those two issues will be discussed next.

C. Limitations of the Traditional "Notice and Consent" Model for IoT

By their very nature, IoT and wearable technologies are always on, always sensing, always collecting, and always communicating. This condition will create major challenges for traditional FIPPs-based policymaking efforts. As FTC Chairwoman Ramirez notes, "the difficulties will be exponentially greater with the advent of the Internet of Things, as the boundaries between the virtual and physical worlds disappear."[231] She goes on to ask a series of questions about the rise of IoT and its implications for privacy best practices:

> Will consumers understand that previously inert everyday objects are now collecting and sharing data about them? How can these objects provide just-in-time notice and choice if

[230] Benjamin Wittes & Wells C. Bennett, *Databuse and a Trusteeship Model of Consumer Protection in the Big Data Era*, GOVERNANCE STUDIES RESEARCH PAPER (Brookings Institution), June 2014, at 1, *available at* http://www.brookings.edu/research/papers/2014/06/04-databuse-trusteeship-consumer-protection-big-data-era-privacy.

[231] Edith Ramirez, Chairwoman, Fed. Trade Comm'n, Opening Remarks at the Internet of Things: Privacy and Security in a Connected World (Nov. 19, 2013), at 4, *available at* http://www.ftc.gov/public-statements/2013/11/opening-remarks-ftc-chairwoman-edith-ramirez-federal-trade-commission.

> there is no user interface at all? And will we be asking consumers to make an unreasonable number of decisions about the collection and use of their data?[232]

"The answers to these and other questions may not be simple," Ramirez says, "but in my mind the question is not whether the core principles of privacy by design, simplified choice, and transparency should apply to the Internet of Things. The question is how to adapt them to the Internet of Things."[233]

Alas, Ramirez does not offer a clear roadmap for how to do so. Nor has the FTC. That is hardly surprising, however, because it is almost impossible to envision how a rigid application of traditional notice and choice procedures to IoT would work in practice. The Future of Privacy Forum notes that while FIPPs "are a valuable set of high-level guidelines for promoting privacy, . . . given the nature of the technologies involved, *traditional* implementations of the FIPPs may not always be practical as the Internet of Things matures."[234]

For example, it is not even clear at the moment whether existing wearable technologies and mobile medical applications are in compliance with—or even need to be in compliance with[235]—the Health Insurance Portability and Accountability Act (HIPAA), which governs the use of "individually identifiable health information held by covered entities and their business associates and gives patients an array of rights with respect to that information."[236] As consumers use their smartphones and tablets as medical monitoring devices to compile data about their health and fitness and then share it with medical professionals or others, it will raise a variety of

---

[232] *Id.*
[233] *Id.*
[234] Future of Privacy Forum, *supra* note 192, at 3 (emphasis in original).
[235] HIPAA's coverage is conditioned on a variety of definitional distinctions involving who or what counts as "protected health information," a "covered entity," a "business associate," and so on. *See* Anne Marie Helm & Daniel Georgatos, *Privacy and Mhealth: How Mobile Health 'Apps' Fit into a Privacy Framework Not Limited to HIPAA*, 64 SYRACUSE L. REV. 152–56 (2014).
[236] U.S. Dep't of Health and Human Services, *Understanding Health Information Privacy*, http://www.hhs.gov/ocr/privacy/hipaa/understanding/index.htm (last visited June 13, 2014).

questions about HIPAA compliance as well as traditional FDA medical device regulatory compliance more generally.[237]

Enforcing privacy best practices in an age of increasing device miniaturization means that, in many cases, it also will not be possible for consumers to read an organization's privacy policy because many of these technologies will be too small to even have a display.[238] Moreover, the sophistication of many of these devices and the sheer amount of data they collect make it difficult to devise a workable notice and choice regime that can foresee every possible misuse. As the recent White House *Big Data* report noted,

> Big data technologies, together with the sensors that ride on the "Internet of Things," pierce many spaces that were previously private . . . . Always-on wearable technologies with voice and video interfaces and the arrival of whole classes of networked devices will only expand information collection still further. This sea of ubiquitous sensors, each of which has legitimate uses, make the notion of limiting information collection challenging, if not impossible.[239]

The White House concluded, "Together, these trends may require us to look closely at the notice and consent framework that has been a central pillar of how privacy practices have been organized for more than four decades."[240] In an accompanying report, the President's Council of Advisors for Science and Technology concluded that, "as a useful policy tool, notice and consent

---

[237] Mark Sullivan, *Health Apps Could Be Heading into a HIPAA Showdown*, VENTUREBEAT (June 13, 2014), http://venturebeat.com/2014/06/13/health-apps-could-be-heading-into-a-hipaa-showdown.

[238] The FDA has already struggled with this problem in the context of digital advertising for prescription drugs and medical devices. In doing so, the agency has actually discouraged the use of some social media sites, such as Twitter, if adequate disclosure is difficult. The draft guidance says, "If the firm concludes that adequate benefit and risk information, as well as other required information, cannot all be communicated within the same tweet, then the firm should reconsider using Twitter for the intended promotional message." *See* FOOD AND DRUG ADMIN., GUIDANCE FOR INDUSTRY INTERNET/SOCIAL MEDIA PLATFORMS WITH CHARACTER SPACE LIMITATIONS: PRESENTING RISK AND BENEFIT INFORMATION FOR PRESCRIPTION DRUGS AND MEDICAL DEVICES 7 (June 2014), *available at* http://www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/UCM401087.pdf.

[239] *Id.* at 53–54.

[240] *Id.* at 54.

is defeated by exactly the positive benefits that big data enables: new, nonobvious, unexpectedly powerful uses of data."[241]

Many academics agree. Peppet says, "notice and choice is an ill fitting solution to these problems, both because Internet of Things devices may not provide consumers with inherent notice that data rights are implicated in their use and because sensor device firms seem stuck in a notice paradigm designed for web sites rather than connected consumer goods."[242]

D. The Possible Move Toward Use Restrictions for IoT

In light of these problems, various academics, government officials, and even private companies have suggested that it may be necessary to move away from a policy approach rooted in notice and choice and toward a new regime based on use restrictions.[243]

Former FTC officials J. Howard Beales and Timothy J. Muris have argued that "government should base commercial privacy regulations and policies on the potential consequences for consumers of information use and misuse. This approach focuses attention on the relevant questions of benefits and costs, and offers a superior foundation for regulation," they say.[244] Similarly, Craig Mundie, a senior advisor at Microsoft, says, "The time has come for a new approach: shifting the focus from limiting the collection and retention of data to controlling

---

[241] Exec. Office of the President, President's Council of Advisors on Science and Technology, BIG DATA AND PRIVACY: A TECHNOLOGICAL PERSPECTIVE 38 (May 2014), *available at* http://www.whitehouse.gov/sites /default/files/microsites/ostp/PCAST/pcast_big_data_and_privacy_-_may_2014.pdf.
[242] Peppet, *supra* note 4, at 55.
[243] Bambauer, *supra* note 227, at 270–71. ("Laws prohibiting specific uses of personal information can achieve the goals of privacy law without significantly curtailing the flow of truthful information. If we have reason to believe that a particular use diminishes social welfare, we can and should craft prohibitions on those specific uses.")
[244] J. Howard Beales III & Timothy J. Muris, *Choice or Consequences: Protecting Privacy in Commercial Information*, 75 U. CHI. L. REV. 109, 132 (2008).

data at the most important point—the moment when it is used."[245] Finally, in a recent report on revising data protection principles, Fred H. Cate of Indiana University, Peter Cullen of Microsoft, and Viktor Mayer-Schönberger of Oxford University argue that

> [a]s a practical matter, the evolution of data collection and data use necessitates an evolving system of information privacy protection. A revised approach should shift responsibility away from individuals and toward data collectors and data users, who should be held accountable for how they manage data rather than whether they obtain individual consent. In addition, a revised approach should focus more on data use than on data collection because the context in which personal information will be used and the value it will hold are often unclear at the time of collection.[246]

Policymakers appear ready to move in this direction. The Obama administration's recent *Big Data* report suggested that "in instances where the notice and consent framework threatens to be overcome—such as the collection of ambient data by our household appliances—we may need to re-focus our attention on the context of data use, a policy shift presently being debated by privacy scholars and technologists."[247] The White House argued that this sort of "responsible use framework" has many potential advantages:

> It shifts the responsibility from the individual, who is not well equipped to understand or contest consent notices as they are currently structured in the marketplace, to the entities that collect, maintain, and use data. Focusing on responsible use also holds data collectors and users accountable for how they manage the data and any harms it causes, rather than narrowly defining their responsibility to whether they properly obtained consent at the time of collection.[248]

Many companies, including many large IoT players, have suggested they are open to such a move. The Transatlantic Computing Continuum Policy Alliance—which includes AT&T,

---

[245] Craig Mundie, *Privacy Pragmatism: Focus on Data Use, Not Data Collection*, FOREIGN AFFAIRS, Mar.–Apr. 2014, *available at* http://www.foreignaffairs.com/articles/140741/craig-mundie/privacy-pragmatism.
[246] FRED H. CATE, PETER CULLEN & VIKTOR MAYER-SCHÖNBERGER, DATA PROTECTION PRINCIPLES FOR THE 21ST CENTURY: REVISING THE 1980 OECD GUIDELINES 8 (2013).
[247] EXEC. OFFICE OF THE PRESIDENT, *supra* note 216, at 56.
[248] *Id.*

General Electric, Intel Corporation, and Oracle Corporation—has filed comments with the FTC arguing as follows:

> We need to move away from an approach centered on the collection of data to focus in practical terms on what happens to that data and how it's used, bearing in mind the real world harms and consequences. That does not mean that there is no role for notice and choice, but rather that we must review the context of the implementation and potential societal benefits from how the information may be used to determine what controls are needed to protect privacy within the circumscribed use. We need to think through how we manage notice and choice—not to change existing privacy principles, but to provide more guidance about how to apply the existing principles in this new IoT environment.[249]

Such a move away from notice and consent and toward use-based limitations seems likely as IoT and wearable technologies evolve and make older enforcement methods less effective.[250] For technologies such as Google Glass and other wearables, it would be impossible for users to obtain notice and consent from every individual they randomly passed by on a sidewalk or at an event. By contrast, it might be possible to impose some limited use-based restrictions of wearables to achieve privacy or safety goals.

For example, the use of wearables in certain sensitive environments (such as bathrooms or locker rooms) could be prohibited. Use-based restrictions might also be imposed for safety-related reasons as well. A state senator in Illinois recently introduced a bill that would prohibit drivers from wearing Google Glass while operating a vehicle.[251] Even if that measure does not pass, it is easy to imagine comparable restrictions being imposed on the use of wearables while driving or operating heavy machinery.

---

[249] Transatlantic Computing Continuum Policy Alliance, cmt. to the Fed. Trade Comm'n on Internet of Things, Project No. P135405 (Jan. 10, 2014), *available at* http://cppionline.org/docs/Letter-to-Secretary_Clark_final.pdf.
[250] Jill Valenstein, *Will Individual Notice and Consent Become a Relic of the Past? The White House Report on Big Data Suggests Privacy Regulation Should Focus on Data Use, Rather Than Data Collection*, PRIVACY & SECURITY LAW BLOG (May 20, 2014), http://www.privsecblog.com/2014/05/articles/main-topics/marketing-consumer-privacy/will-individual-notice-and-consent-become-a-relic-of-the-past-the-white-house-report-on-big-data-suggests-privacy-regulation-should-focus-on-data-use-rather-than-data-collection.
[251] John Byrne, *Illinois Lawmaker Wants to Outlaw Wearing Google Glass While Driving*, CHI. TRIB., May 20, 2014, *available at* http://articles.chicagotribune.com/2014-05-20/news/chi-illinois-google-glass-law-driving-20140520_1_google-glass-illinois-lawmaker-silverstein.

E. The Problem of "Privacy Paternalism" and the Limits of Privacy "Harm"

In crafting use-based restrictions, however, policymakers must exercise caution. Overly broad restraints could end up being tantamount to a de facto ban on *all* uses of certain IoT or wearable technologies. Moreover, policymakers must avoid converting their preferences—or the preferences of just a small but vocal group of regulation advocates—into paternalistic policies that limit individual autonomy.[252] The goal of privacy policy should not be to prevent people from making choices that others feel are unwise.

Privacy scholar Daniel J. Solove of the George Washington University School of Law has warned about privacy law's "paternalism" problem.[253] "Privacy regulation," he notes, "risks becoming too paternalistic. Regulation that sidesteps consent denies people the freedom to make choices. The end result is that either people have choices that are not meaningful or people are denied choices altogether."[254]

Privacy is too subjective to have policymakers or academics dictating outcomes on the basis of their own preferences.[255] As Solove notes, "the correct choices regarding privacy and data use are not always clear. For example, although extensive self-exposure can have disastrous consequences, many people use social media successfully and productively."[256] Generally speaking, barring a clear showing of actual—not prospective or hypothetical—harm,[257] U.S.

---

[252] Adam Thierer, *Is Privacy an Unalienable Right? The Problem with Privacy Paternalism*, TECH. LIBERATION FRONT (Jan. 18, 2014), http://techliberation.com/2014/01/27/is-privacy-an-unalienable-right-the-problem-with-privacy-paternalism.

[253] Daniel J. Solove, *Privacy Self-Management and the Consent Dilemma*, 126 HARV. L. REV. 1880, 1895 (2013).

[254] *Id.* at 1894.

[255] *See* Thierer, *supra* note 228, at 414–21; Thomas M. Lenard & Paul H. Rubin, *The Big Data Revolution: Privacy Considerations* 24 (Technology Policy Institute, Working Paper, 2013), *available at* http://www.techpolicyinstitute.org/files/lenard_rubin_thebigdatarevolutionprivacyconsiderations.pdf (worrying that "many of the privacy advocates and writers on the subject do not trust the consumers for whom they purport to advocate").

[256] Solove, *supra* note 253, at 1895.

[257] *Id.* at 1897 ("The law generally does not override consent, even with potentially dangerous activities. . . . As a general matter, the law refrains from restricting transactions that appear on the surface to be consensual, and the law

culture has rejected the paternalistic idea that law must "save us from ourselves" (i.e., from citizens' own irrationality or mistakes).[258] Importantly, the term *harm* in this context has usually been narrowly defined as action that poses a direct threat to human well-being, personal property, or the home.[259] This is not to say emotional or psychic harm associated with privacy violations are ignored completely under U.S. law,[260] merely that a much higher bar exists when attempting to make the case that those harms should be legally actionable.[261]

That approach generally makes sense in light of both how subjective privacy can be and the high value Americans place on privacy in balancing it against other values, such as freedom of speech and journalistic freedoms (which will be discussed in the next section), as well as economic innovation and consumer choice. "We have fallen in love with this always-on world," note Hal Abelson, Ken Ledeen, and Harry Lewis, authors of *Blown to Bits: Your Life, Liberty, and Happiness After the Digital Explosion*. "We accept our loss of privacy in exchange for efficiency, convenience, and small price discounts."[262] Although many privacy advocates are loath to hear it, the reality is that "we give away information about ourselves—voluntarily leave visible footprints of our daily lives—because we judge, perhaps without thinking about it very

---

will tolerate a substantial amount of manipulation and even coercion before it deems a transaction to be nonconsensual.").

[258] *Id.* at 1897 ("People make decisions all the time that are not in their best interests. People relinquish rights and take bad risks, and the law often does not stop them.").

[259] Jim Harper, *The Privacy Torts: How U.S. State Law Quietly Leads the Way in Privacy Protection*, SPECIAL REPORT (Privacilla), July 2002, *available at* http://www.privacilla.org/releases/Torts_Report.html ("Prescriptive regulation may be called for where there is significant risk to human life or health because the injuries people may suffer are irreversible or deadly. This makes compensation after the fact impossible or insufficient. Though suffering a privacy violation can be devastating, information policy can not be fairly characterized as an area of significant danger to human life or health.").

[260] *See* Daniel J. Solove, *Privacy and Data Security Violations: What's the Harm?*, LINKEDIN (June 25, 2014), https://www.linkedin.com/today/post/article/20140625045136-2259773-privacy-and-data-security-violations-what-s-the-harm; Ryan Calo, *The Boundaries of Privacy Harm*, 86 INDIANA L. J. 1132 (2011), *available at* http://ilj.law.indiana.edu/articles/86/86_3_Calo.pdf.

[261] Adam Thierer, *Privacy Law's Precautionary Principle Problem*, 66 MAINE L. REV. 467, 473–79 (2014), *available at* http://www.mainelawreview.com/wp-content/uploads/2014/06/05-Thierer.pdf

[262] ABELSON ET AL., *supra* note 8, at 20.

much, that the benefits outweigh the costs. To be sure, the benefits are many," argue Abelson, Ledeen, and Lewis.[263]

This is why America's privacy torts typically involve a careful weighing of competing values and why courts usually try to strike a balance among them. "Reasonable minds are bound to differ when deciding whether the likely psychic harms outweigh the social gains," notes Jane Yakowitz Bambauer of the University of Arizona College of Law. "The values on both sides of the scale are inordinately difficult to measure."[264]

For those reasons, use-based restrictions should not be converted into a regulatory straitjacket that uniformly mandates data collection and use practices according to a static, one-size-fits-all blueprint. The need for flexibility and adaptability will be paramount if innovation is to continue in this space.[265]

For example, if policymakers attempt to craft a use-based restriction that prohibits the use of wearable data on grounds that it could be used to discriminate against users, lawmakers should narrowly tailor that rule to address truly invidious forms of racial, sexual, or religious discrimination.[266] Of course, many antidiscrimination laws that might make such practices illegal anyway already exist.[267] But the term *discrimination* should not be construed to include any form

---

[263] *Id.* at 36.
[264] Bambauer, *supra* note 227, at 261.
[265] Future of Privacy Forum, supra note 192, at 6 ("Even in circumstances where traditional [privacy policy] implementations may seem appropriate, however, flexibility is needed.").
[266] Sam Pfeifle, *How Big Data Discriminates*, PRIVACY ADVISOR (June 24, 2014), https://www.privacyassociation.org/publications/how_big_data_discriminates.
[267] Bambauer, *supra* note 227, at 271 ("Antidiscrimination laws are prime examples of narrow use restrictions. Antidiscrimination laws restrict the use of race, age, sex, or medical information for hiring, housing, and lending decisions because the biases that result from use of this information, whether statistically rational or not, run against the public interest. These laws work well on the risk-utility calculator because they allow information to be exploited for all purposes except the ones that have been determined to be harmful or risky. The large, rich scholarship on discrimination law explores and debates the soundness of anti-discrimination measures. Curiously, the privacy and discrimination fields often work in isolation, without overt awareness that regulations called 'privacy laws' and those called 'antidiscrimination laws' often aim to prevent the same harms" [internal citations omitted].).

of service differentiation, such as tailored product offerings that help expand the range of consumer services.[268] In the future, some IoT developers might craft creative data sharing policies that provide consumers with a wide variety of unanticipated benefits. Serendipitous discoveries and data-driven innovation can materialize only in a policy environment that embraces trial-and-error experimentation.[269] That is why flexible data collection and use proposals and evolving best practices will ultimately serve consumers better than one-size-fits all, top-down regulatory edicts.

Even well-intentioned regulation can create complex and sometimes quite costly tradeoffs.[270] Data collection has fueled a remarkable amount of the innovation in the modern economy.[271] Privacy-related mandates that propose curtailing the use of data could have several deleterious effects, including higher costs for consumers, a decrease in the content and services supported by that data collection and advertising, increased costs for smaller operators and new start-ups (meaning less competition overall), and perhaps even a decrease in America's global competitive advantage in the digital economy.[272]

---

[268] For general discussion of benefits of price discrimination, *see* Hal Varian, *Price Discrimination*, *in* 1 HANDBOOK OF INDUSTRIAL ORGANIZATION 597–654 (Richard Schmalensee & Robert Willig eds., 1989).

[269] THIERER, *supra* note 7, at 1, 17, 81; Letter from Daniel Castro, *supra* note 13 ("The federal government can play a major role in maximizing the potential benefits of big data, but it must above all encourage use and reuse of data. This means allowing data to be collected and retained for serendipitous future applications that were not foreseen at the time of collection, while restricting harmful applications.").

[270] *See* Thierer, *supra* note 192, at 1055–105.

[271] JOHN DEIGHTON & PETER A. JOHNSON, THE VALUE OF DATA: CONSEQUENCES FOR INSIGHT, INNOVATION & EFFICIENCY IN THE U.S. ECONOMY 5 (2013), *available at* http://ddminstitute.thedma.org/#valueofdata (finding that data-driven marketing added $156 billion in revenue to the U.S. economy and fueled more than 675,000 jobs in 2012). *See also* SOFTWARE & INFORMATION INDUSTRY ASSOCIATION, THE U.S. SOFTWARE INDUSTRY: AN ENGINE FOR ECONOMIC GROWTH AND EMPLOYMENT (Sept. 2014), *available at* http://siia.net/index.php?option=com_content&view=article&id=1293:data-driven-innovation&catid=163:public-policy-articles&Itemid=1411; Press Release, Gartner, Gartner Says Big Data Will Drive $28 Billion of IT Spending in 2012 (Oct. 17, 2012), *available at* http://www.gartner.com/newsroom/id/2200815; JAMES MANYIKA, MICHAEL CHUI, BRAD BROWN, JACQUES BUGHIN, RICHARD DOBBS, CHARLES ROXBURGH & ANGELA HUNG BYERS, BIG DATA: THE NEXT FRONTIER FOR INNOVATION, COMPETITION, AND PRODUCTIVITY 97–106 (May 2011), *available at* http://www.mckinsey.com/insights/business_technology/big_data_the_next_frontier_for_innovation.

[272] *See Status Update*, *supra* note 193, at 2.

All these considerations and tradeoffs apply equally to IoT and wearable technologies. Health and fitness application providers already collect and sell a certain amount of user information to advertisers so they can create richer user profiles and deliver more relevant ads.[273] Some users may find that creepy, but this process is what ensures the cost of such services remains low or even altogether free of charge. And users are always free to avoid such services completely if they fear such data collection practices.

Instead of imposing these FIPPs in a rigid regulatory fashion, therefore, these privacy and security best practices will need to evolve gradually to new realities and be applied in a more organic and flexible fashion, often outside the realm of public policy. For example, providing consumers with adequate information about various data collection practices remains a sensible best practice for developers to follow, even if it proves difficult to enforce by law. Likewise, IoT developers would be wise to be highly transparent about their data use policies and also limit the amount of overall data collection to core functions as much as possible. Finally, they should limit retention of that data, limit sharing with too many third parties, and safeguard the data they collect against unauthorized interception or data breaches.

The key takeaway from this discussion is that no silver-bullet solution to these complex privacy issues exists. As analysts with Morrison Foerster have argued, "threats to security and privacy vary considerably, and the breadth of challenges presented means that a one-size-fits-all approach to policy and/or regulation is unlikely to work."[274] What is needed is a layered approach. Some potential responses will be outlined in section VI of this paper. But one additional complication needs to be discussed first: the First Amendment.

---

[273] Thorin Klosowski, *Lots of Health Apps Are Selling Your Data: Here's Why*, LIFEHACKER (May 9, 2014), http://lifehacker.com/lots-of-health-apps-are-selling-your-data-heres-why-1574001899.
[274] Collins et al., *supra* note 166, at 2.

F. First Amendment–Related Hurdles to the Regulation of IoT and Wearable Technology

To the extent that wearable technologies are used by individuals to record and gather video, audio, and other data, First Amendment rights may be implicated. There has long existed a tension between privacy and free speech rights, which will be greatly exacerbated by the rise of these IoT technologies.

Legal scholar Rodney A. Smolla notes that "strong First Amendment doctrines stand in the way of many of the most meaningful privacy reforms."[275] In particular, legal scholars have long noted that press rights are also affected by stronger commercial privacy controls. Philosopher Judith Jarvis Thomson argues that "even if there is a right to not be caused distress by the publication of personal information, it is mostly, if not always, overridden by what seems to me a more stringent right, namely the public's right to a press which prints any and all information, personal or impersonal, which it deems newsworthy."[276]

But more than just journalistic freedoms are at stake here. The First Amendment protects the right of all citizens to observe and freely gather information about the world around them and to use various technologies to help them do so. As the Seventh Circuit explained in its 2012 decision in *ACLU of Illinois v. Alvarez*,

> The act of *making* an audio or audiovisual recording is necessarily included within the First Amendment's guarantee of speech and press rights as a corollary of the right to disseminate the resulting recording. The right to publish or broadcast an audio or audiovisual recording would be insecure, or largely ineffective, if the antecedent act of *making* the recording is wholly unprotected, as the State's Attorney insists. By way of a simple analogy, banning photography or note-taking at a public event would raise serious First Amendment concerns; a law of that sort would obviously affect the right to publish the resulting photograph or disseminate a report derived from the notes. The same is true of a ban on audio and audiovisual recording.[277]

---

[275] Rodney A. Smolla, *Privacy and the First Amendment Right to Gather News*, 67 GEO. WASH. L. REV. 1097, 1098 (1999).
[276] Judith Jarvis Thomson, *The Right to Privacy*, 4 PHILOSOPHY AND PUBLIC AFFAIRS 295, 310 (1975).
[277] ACLU of Illinois v. Alvarez, 679 F.3d 583, 595–96 (7th Cir. 2012).

Although some privacy theorists argue that data and data collection are not protected speech deserving First Amendment protection,[278] other scholars recognize that restrictions on data collection are restrictions on the free flow of information, which implicate the First Amendment.[279] This reasoning is supported by the Supreme Court's 2011 decision in *Sorrell v. IMS Health Inc.*, which struck down a state law prohibiting data aggregators from selling personal information to pharmaceutical companies, which in turn use the data to customize their marketing pitches to doctors.[280] In line with a lower court ruling, the Supreme Court found that the regulation violated the First Amendment because it restricts the speech rights of data miners without directly advancing legitimate state interests.[281] The Court's ruling means that restrictions on the sale, disclosure, and use of personally identifying information will be subject to heightened judicial scrutiny in the future.

This makes it clear how the First Amendment might pose a serious roadblock to more comprehensive regulation of IoT and wearable technologies—regardless of whether these devices and services are being used for commercial or noncommercial purposes. For example, consider technologies such as Google Glass and wearable clip-on cameras, which were discussed earlier. When individuals use these technologies in public spaces, it is likely that their First Amendment rights to record information and interactions would trump most privacy

---

[278] Neil M. Richards, *Reconciling Data Privacy and the First Amendment*, 52 UCLA L. REV. 1149, 1173–74 (2005); Tim Wu, *Free Speech for Computers?*, N.Y. TIMES, June 19, 2012, *available at* http://www.nytimes.com/2012/06/20/opinion/free-speech-for-computers.html.

[279] Jane Yakowitz Bambauer, *Is Data Speech?*, 66 STAN. L. REV. 57 (2014), *available at* http://ssrn.com/abstract=2231821 ("Data privacy laws regulate minds, not technology. Thus, for all practical purposes, and in every context relevant to the privacy debates, data is speech.").

[280] Sorrell v. IMS Health Inc., 131 S. Ct. 2653, 2660 (2011).

[281] *Id.* at 2672; Yara Tercero-Parker, *U.S. Supreme Court Questions State Drug Data Restrictions*, ETHICS ILLUSTRATED (Apr. 27, 2011), http://www.bioethicsinternational.org/blog/2011/04/27/us-supreme-court-questions-state-drug-data-restrictions.

considerations.[282] "Current U.S. privacy law recognizes only a very limited right of privacy in public, one that would likely not bar citizens from . . . gathering information through augmented-reality spectacles," says Daxton "Chip" Stewart of Texas Christian University's College of Communication.[283] That will be equally true for many other IoT and wearable technologies.

Thus, when considering the application of traditional FIPPs in this context, policymakers would be wise to remember law professor Eugene Volokh's observation:

> We already have a code of "fair information practices," and it is the First Amendment, which generally bars the government from controlling the communication of information (either by direct regulation or through the authorization of private lawsuits), whether the communication is "fair" or not.[284]

This does not mean that government is completely powerless to impose privacy-related restrictions on some information-gathering efforts. As will be noted in section VI, some targeted statutes already exist that limit information gathering in highly sensitive contexts outside the scope of First Amendment protection.[285] For example, though citizens have broad liberties to use cameras and recording devices in public, privacy torts and "peeping Tom" laws prohibit intrusive or surreptitious recording in private spaces or even in many public places. Also, the use of wearables in private spaces could be constrained by private contracts and property rights considerations, although enforcement challenges will be evident in this context, too. In other words, although limiting data collection proves challenging (either because of the practicality of

---

[282] Seth F. Kreimer, *Pervasive Image Capture and the First Amendment: Memory, Discourse, and the Right to Record*, 159 U. PA. L. REV. 335, 398 (2011), *available at* http://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=1085&context=penn_law_review ("Once we recognize that image capture is protected by principles of free expression, proposals to impose liability without observing the established limitations of privacy torts—either by common law innovation or by statute—raise serious constitutional questions. Such liability would facilitate interference with efforts by private individuals to preserve their observations for future review, reflection, and dissemination without any actual demonstration to a court of substantial countervailing privacy interests.").
[283] Stewart, *supra* note 126.
[284] Eugene Volokh, *Freedom of Speech and Information Privacy: The Troubling Implications of a Right to Stop People from Speaking About You*, 52 STAN. L. REV. 1049, 1050–51 (2000) (footnote omitted).
[285] *See* Bambauer, *supra* note 227.

doing so or because of First Amendment considerations), it might be possible to impose some limits or penalties on data dissemination after the fact.

In sum, more expansive regulatory efforts aimed at clamping down on information collection efforts using IoT and wearable technologies are bound to face formidable First Amendment–related challenges.[286] Policymakers will need to narrowly tailor privacy-related measures if they hope to avoid these complications.

V. The Role of Resiliency and Gradual Social Adaptation

Before discussing some of the ways that the public and policymakers might constructively address concerns about IoT and wearable technology, it is worth discussing the important—and quite often overlooked—role that social and individual adaptation plays with regard to new inventions.[287]

A. From Resistance to Resiliency

Citizen attitudes about these technologies will likely follow a cycle that has played out in countless other contexts. That cycle typically witnesses initial *resistance*, gradual *adaptation*, and then eventual *assimilation* of a new technology into society.[288] Some citizens will begin their relationship with these new technologies in a defensive crouch. In the extreme, if there is enough

[286] Fred H. Cate & Robert Litan, *Constitutional Issues in Information Privacy*, 9 MICH. TELECOMM. & TECH. L. REV. 35, 51 (2002) ("[T]o the extent that privacy laws restrict expression, even if that expression is commercial, the First Amendment imposes a considerable burden on the government to demonstrate the need and effectiveness of those laws.").
[287] Adam Thierer, *Muddling Through: How We Learn to Cope with Technological Change*, TECHNOLOGY LIBERATION FRONT (June 17, 2014), http://techliberation.com/2014/06/17/muddling-through-how-we-learn-to-cope-with-technological-change.
[288] *See* THIERER, *supra* note 7, at 53–60.

of a backlash, the initial resistance to these technologies might take the form of a full-blown "technopanic."[289]

Over time, however, citizens tend to learn how to adapt to new technologies or at least become more resilient in the face of new challenges posed by modern technological advances. Andrew Zolli and Ann Marie Healy, authors of *Resilience: Why Things Bounce Back*, define *resilience* as "the capacity of a system, enterprise, or a person to maintain its core purpose and integrity in the face of dramatically changed circumstances."[290] They continue,

> To improve your resilience is to enhance your ability to resist being pushed from your preferred valley, while expanding the range of alternatives that you can embrace if you need to. This is what researchers call *preserving adaptive capacity*—the ability to adapt to changed circumstances while fulfilling one's core purpose—and it's an essential skill in an age of unforeseeable disruption and volatility.[291]

Consequently, they note, "by encouraging adaptation, agility, cooperation, connectivity, and diversity, resilience-thinking can bring us to a different way of being in the world, and to a deeper engagement with it."[292]

Those who propose more precautionary solutions to challenging social problems often ignore this uncanny ability of individuals and institutions to "bounce back" from technological disruptions and become more resilient in the process. Part of the reason precautionary thinking sometimes dominates discussions about emerging technologies is that many people hold a deep-seated pessimism about future developments and a belief that, with enough preemptive planning, they can anticipate and overcome any number of hypothetical worst-case scenarios. Consequently, their innate tendency not only to be pessimistic but also to want greater certainty

---

[289] Adam Thierer, *Technopanics, Threat Inflation, and the Danger of an Information Technology Precautionary Principle*, 14 MINN. J. L. SCI. & TECH. 309 (2013).
[290] ANDREW ZOLLI & ANN MARIE HEALY, RESILIENCE: WHY THINGS BOUNCE BACK 7 (2012).
[291] *Id.* at 7–8.
[292] *Id.* at 16.

about the future means that "the gloom-mongers have it easy," notes author Dan Gardner.[293] "Their predictions are supported by our intuitive pessimism, so they *feel* right to us. And that conclusion is bolstered by our attraction to certainty."[294] Clive Thompson, a contributor to *Wired* and the *New York Times Magazine*, also notes that "dystopian predictions are easy to generate" and "doomsaying is emotionally self-protective: if you complain that today's technology is wrecking the culture, you can tell yourself you're a gimlet-eyed critic who isn't hoodwinked by high-tech trends and silly, popular activities like social networking. You seem like someone who has a richer, deeper appreciation for the past and who stands above the triviality of today's life."[295]

Luckily, as science reporter Joel Garreau reminds readers, "the good news is that end-of-the-world predictions have been around for a very long time, and none of them has yet borne fruit."[296] Doomsayers have a bad track record because they typically ignore how "humans shape and adapt [technology] in entirely new directions."[297] "Just because the problems are increasing doesn't mean solutions might not also be increasing to match them," Garreau correctly notes.[298]

In their 2001 "Response to Doom-and-Gloom Technofuturists," John Seely Brown and Paul Duguid note that "technological and social systems shape each other. . . . [They] are constantly forming and reforming new dynamic equilibriums with far-reaching implications." "Social and technological systems do not develop independently," they continue. Rather, "the

---

[293] DAN GARDNER, FUTURE BABBLE: WHY EXPERT PREDICTIONS ARE NEXT TO WORTHLESS, AND YOU CAN DO BETTER 140–41 (2011).
[294] John Seely Brown & Paul Duguid, *Response to Bill Joy and the Doom-and-Gloom Technofuturists*, *in* AAAS SCIENCE AND TECHNOLOGY POLICY YEARBOOK 2001 79 (Albert H. Teich, Stephen D. Nelson, Celia McEnaney & Stephen J. Lita eds., 2001).
[295] CLIVE THOMPSON, SMARTER THAN YOU THINK: HOW TECHNOLOGY IS CHANGING OUR MINDS FOR THE BETTER 283 (2013).
[296] GARREAU, *supra* note 146, at 148.
[297] *Id.* at 95.
[298] *Id.* at 154.

two evolve together in complex feedback loops, wherein each drives, restrains, and accelerates change in the other."[299]

This is how humans become more resilient and prosper, even in the face of sweeping technological change. Wisdom is born of experience, including experiences that involve risk and the possibility of occasional mistakes and failures while both developing new technologies and learning how to live with them.[300] Citizens should remain open to new forms of technological change not only because doing so provides breathing space for future entrepreneurialism and invention, but also because it provides an opportunity to see how societal attitudes toward new technologies evolve—and to learn from that change. More often than not, citizens find creative ways to adapt to technological change by using a variety of coping mechanisms, new norms, or other creative fixes. Although some things are lost in the process, something more is typically gained, including lessons about how to deal with subsequent disruptions.

B. Case Study: The Rise of Public Photography

Consider the jarring impact that the rise of the camera and public photography had on American society in the late 1800s.[301] This case study has implications for the debate over wearable technologies. Plenty of critics existed, and many average citizens were probably outraged by the spread of cameras[302] because "for the first time photographs of people could be taken without their permission—perhaps even without their knowledge," notes Lawrence M. Friedman in his

[299] Brown & Duguid, *supra* note 294, at 79, 82, 83.
[300] THIERER, *supra* note 7, at viii.
[301] This section was condensed from Thierer, *supra* note 287.
[302] For a discussion of the anxieties caused by photography during this time, *see* Robert E. Mensel, *Kodakers Lying in Wait: Amateur Photography and the Right of Privacy in New York, 1885–1915*, 43 AMER. QUAR. 24 (March 1991).

2007 book, *Guarding Life's Dark Secrets: Legal and Social Controls over Reputation, Propriety, and Privacy*.[303]

In fact, the most important essay ever written on privacy law, Samuel D. Warren and Louis D. Brandeis's famous 1890 *Harvard Law Review* essay "The Right to Privacy," decries the spread of public photography. The authors lament that "instantaneous photographs and newspaper enterprise have invaded the sacred precincts of private and domestic life" and claim that "numerous mechanical devices threaten to make good the prediction that 'what is whispered in the closet shall be proclaimed from the house-tops.'"[304]

Despite the profound disruption caused by cameras and public photography, personal norms and cultural attitudes evolved quite rapidly as cameras became a central part of the human experience. In fact, instead of shunning cameras, most people quickly looked to buy one! At the same time, social norms and etiquette evolved to address those who would use cameras in inappropriate or privacy-invasive ways. In other words, citizens bounced back and became more resilient in the face of technological adversity.

Although some limited legal responses were needed to address the most egregious misuses of cameras, for the most part the gradual evolution of social norms, public pressure, and other coping mechanisms combined to solve the "problem" of public photography. As will be noted in the next section, in much the same way IoT and wearable technology will likely see a similar combination of factors at work as individuals and society slowly adjust to the new technological realities of the time. The public will likely develop coping mechanisms to deal with the new realities of a world of wearable technologies and become more resilient in the process.

---

[303] LAWRENCE M. FRIEDMAN, GUARDING LIFE'S DARK SECRETS: LEGAL AND SOCIAL CONTROLS OVER REPUTATION, PROPRIETY, AND PRIVACY 214 (2007).
[304] Samuel D. Warren & Louis D. Brandeis, *The Right to Privacy*, 4 HARV. L. REV. 193, 195 (1890).

That being said, resiliency should not be equated with complacency or a "just-get-over-it" attitude toward privacy and security issues. With time, it may very well be the case that people "get over" *some* of the anxieties they might hold today concerning these new technologies, but in the short run, IoT and wearable technologies will create serious social tensions that deserve serious responses.[305] This paper will turn to some of those potential responses next.

VI. Constructive Solutions to Complex Problems

Even if it is true that precautionary regulation will be costly, counterproductive, or potentially ineffective—and should therefore be avoided if possible—this does not mean the various privacy and security challenges associated with IoT and wearable technologies can be ignored.

As noted already, there are no silver-bullet solutions that can instantly or easily solve these complex problems. Instead, what is needed is a *layered* approach to addressing these concerns that incorporates many different solutions. This section outlines a variety of constructive approaches that can be tapped to address the various privacy and security concerns associated with these new innovations.

A. Digital Literacy: How Education and Etiquette Can Help

One solution to the privacy, security, and safety concerns raised by IoT and wearable technologies is to better educate the public about the potential downsides associated with these

[305] Adam Thierer, *Can We Adapt to the Internet of Things?*, PRIVACY PERSPECTIVES (June 19, 2013), https://www.privacyassociation.org/privacy_perspectives/post/can_we_adapt_to_the_internet_of_things.

technologies, as well as their proper and improper uses.[306] This can be accomplished with a variety of education and awareness-building efforts.[307]

Such efforts are already the primary means of dealing with concerns about online child safety.[308] Much like today's policy debates over online privacy, early policy debates over online child safety focused on top-down regulatory solutions, including efforts to censor objectionable content.[309] These efforts to devise legislative and regulatory responses to online safety concerns immediately faced both technical and legal challenges. Technically speaking, devising workable filtering mechanisms for a medium such as the Internet proved elusive. In terms of the law, at least in the United States, various First Amendment–based constraints made it impossible to devise constitutionally permissible restrictions.[310]

After many years of trying and failing to impose such restrictions, policymakers and online safety experts instead turned their attention to educational and empowerment-based solutions.[311] The educational approaches that they tapped—which focused on media literacy strategies, critical thinking skills, and "digital citizenship"—are equally relevant in the context of online privacy.[312] Digital citizenship efforts stress the importance of teaching both children and adults better online behavior, or "netiquette" (proper behavior toward others), which can promote

---

[306] Thierer, *supra* note 261, at 479.
[307] Howard Beales, Richard Craswell & Steven C. Salop, *The Efficient Regulation of Consumer Information*, 24 J. L. & ECON. 491, 531 (1981) ("Consumer education is often overlooked as a means of dealing with incomplete information.").
[308] *See* ADAM THIERER, PARENTAL CONTROLS & ONLINE CHILD PROTECTION: A SURVEY OF TOOLS (Version 4.0) (2009), *available at* http://www.pff.org/parentalcontrols/.
[309] Thierer, *supra* note 261, at 479–82.
[310] Reno v. ACLU, 521 U.S. 844 (1997).
[311] *See* Adam Thierer, *Five Online Safety Task Forces Agree: Education, Empowerment & Self-Regulation Are the Answer*, 16 PROGRESS ON POINT 1 (July 2009), available at http://www.pff.org/issues-pubs/pops/2009/pop16.13-five-online-safety-task-forces-agree.pdf; U.S. NAT'L TELECOMM. & INFO. ADMIN., YOUTH SAFETY ON A LIVING INTERNET: REPORT OF THE ONLINE SAFETY AND TECHNOLOGY WORKING GROUP (June 4, 2010), *available at* http://www.ntia.doc.gov/legacy/reports/2010/OSTWG_Final_Report_060410.pdf.
[312] COMMON SENSE MEDIA, DIGITAL LITERACY AND CITIZENSHIP IN THE 21ST CENTURY: EDUCATING, EMPOWERING, AND PROTECTING AMERICA'S KIDS (June 2009), *available at* https://www.itu.int/council/groups/wg-cop/second-meeting-june-2010/CommonSenseDigitalLiteracy-CitizenshipWhitePaper.pdf.

both online safety and digital privacy goals.[313] Digital literacy and digital citizenship efforts can help individuals understand the potential perils of oversharing information about themselves and others while simultaneously encouraging consumers to occasionally delete unnecessary online information and cover their digital footprints in other ways.[314] "We live in what one might call the Peeping Tom society," argues Stanford law professor Lawrence M. Friedman, in that "new technology puts powerful tools for invading privacy into the hands of ordinary people."[315] Digital literacy and digital citizenship efforts can help address that problem.

The Obama administration's *Big Data* report included a short section on the need to "recognize digital literacy as an important 21st century skill." It noted,

> In order to ensure students, citizens, and consumers of all ages have the ability to adequately protect themselves from data use and abuse, it is important that they develop fluency in understanding the ways in which data can be collected and shared, how algorithms are employed and for what purposes, and what tools and techniques they can use to protect themselves. Although such skills will never replace regulatory protections, increased digital literacy will better prepare individuals to live in a world saturated by data. Digital literacy—understanding how personal data is collected, shared, and used—should be recognized as an essential skill in K-12 education and be integrated into the standard curriculum.[316]

In 2013, scholars affiliated with the Center on Law and Information Policy at the Fordham University School of Law released a good model for how to operationalize this vision. They launched a privacy education program "aimed at engaging middle school students in

---

[313] Anne Collier, *From Users to Citizens: How to Make Digital Citizenship Relevant*, NET FAMILY NEWS (Nov. 16, 2009), http://www.netfamilynews.org/2009/11/from-users-to-citizen-how-to-make.html; Larry Magid, *We Need to Rethink Online Safety*, HUFFINGTON POST BLOG (Jan. 22, 2010), http://www.huffingtonpost.com/larry-magid/we-need-to-rethink-online_b_433421.html.

[314] Brian O'Neill & Yiannis Laouris, *Teaching Internet Safety, Promoting Digital Literacy: The Dual Role of Education and Schools*, *in* TOWARDS A BETTER INTERNET FOR CHILDREN? POLICY PILLARS, PLAYERS AND PARADOXES 193 (Brian O'Neill, Elisabeth Staksrud & Sharon McLaughlin eds., 2013).

[315] FRIEDMAN, *supra* note 303, 259, 269.

[316] EXEC. OFFICE OF THE PRESIDENT, *supra* note 216, at 64.

discussions about privacy and its relevance in their lives."[317] The resulting Volunteer Privacy Educators Program offered students some lessons about how to deal with social media and how to actively manage their digital reputation, as well as how to establish strong passwords and avoid behavioral advertising, if they were so inclined.[318]

Governments can play an important role in facilitating education and awareness-building approaches. The FTC notes, "Consumer and business education serves as the first line of defense against fraud, deception, and unfair practices."[319] Toward that end, the FTC already partners with over a dozen other federal agencies to provide OnGuardOnline, a website that offers wide-ranging security, safety, and privacy tips for both consumers and businesses.[320] Also, the FTC has created a YouTube page featuring informational videos on these issues.[321] The Federal Communications Commission also offers smartphone security advice on its website.[322] Many privacy activists and privacy professionals already offer extensive educational programs and advice.[323]

---

[317] *Volunteer Privacy Educators Program*, FORDHAM CENTER ON LAW AND INFORMATION POLICY, http://law.fordham.edu/center-on-law-and-information-policy/30317.htm (last visited June 13, 2014).

[318] FORDHAM CENTER ON LAW AND INFORMATION POLICY, FORDHAM CLIP VOLUNTEER PRIVACY EDUCATORS PROGRAM (2013), *available at* http://law.fordham.edu/assets/CLIP/2013_CLIP_VPE_Complete.pdf.

[319] FED. TRADE COMM'N, STRATEGIC PLAN FOR FISCAL YEARS 2009 TO 2014 4 (2009), *available at* http://www.ftc.gov/opp/gpra/spfy09fy14.pdf ("Most FTC law enforcement initiatives include a consumer and/or business education component aimed at preventing consumer injury and unlawful business practices, and mitigating financial losses. From time to time, the agency conducts pre-emptive consumer and business education campaigns to raise awareness of new or emerging marketplace issues that have the potential to cause harm. The agency creatively uses new technologies and private and public partnerships to reach new and under-served audiences, particularly those who may not seek information directly from the FTC.").

[320] The website is at http://www.onguardonline.gov/about-us (last visited Oct. 31, 2014).

[321] The YouTube page is at https://www.youtube.com/user/FTCvideos (last visited Oct. 31, 2014).

[322] FCC Smartphone Security Checker, FED. TRADE COMM'N, http://www.fcc.gov/smartphone-security (last visited Oct. 31, 2014).

[323] David Hoffman, *What's One Way Organizations Can Be More Accountable? Privacy Education*, PRIVACY PERSPECTIVES (Apr. 2, 2013), https://www.privacyassociation.org/privacy_perspectives/post/whats_one_way_organizations_can_be_more_accountable_educate_educate_educate; Sacco, *supra* note 209.

B. Best Practices and Self-Regulation: Privacy and Security "By Design"

Privacy and data security policies for IoT and wearable technology can also be governed by self-regulatory efforts.[324] Developers have a vested interest in adopting best practices and codes of conduct because "only by developing solutions that are clearly respectful of people's privacy, and devoting an adequate level of resources for disseminating and explaining the technology to the mass public" can companies expect to achieve widespread adoption of IoT technologies.[325]

"Compared to traditional government regulation," notes FTC Commissioner Maureen Ohlhausen, "self-regulation has the potential to be more prompt, flexible, and responsive when business models or technologies change."[326] Ohlhausen itemizes other advantages of self-regulation as follows:

- It is "easier to reconfigure than major regulatory systems that must be adjusted via legislation or agency rulemaking."
- It "can also be well attuned to market realities where self-regulatory organizations have obtained the support of member firms. Their accumulated judgment and hands-on experience in their industries help create rules that are workable for companies."
- It "also helps prompt compliance by allowing corporations to 'buy-in' to the process."
- It "may also offer a less adversarial, more efficient dispute resolution mechanism than formal legal procedures . . . ."
- It is "a useful option to resolve consumer concerns, so that government enforcement resources can be preserved for the most egregious cases of consumer harm . . . ."

---

[324] Jedidiah Bracy, *Will Industry Self-Regulation Be Privacy's Way Forward?*, PRIVACY ADVISOR (June 24, 2014), https://www.privacyassociation.org/publications/will_industry_self_regulation_be_privacys_way_forward.
[325] RFID WORKING GROUP, *supra* note 50, at 21.
[326] Maureen K. Ohlhausen, *Success in Self-Regulation: Strategies to Bring to the Mobile and Global Era*, address to the Better Business Bureau Self-Regulation Conference (June 2014), at 3, *available at* http://www.ftc.gov/system/files/documents/public_statements/410391/140624bbbself-regulation.pdf.

- "[T]he cost burden of a self-regulatory process falls on industry participants rather than American taxpayers."[327]

Importantly, Ohlhausen notes that "self-regulation may also be the only option for certain types of activity where government intervention is limited by the First Amendment."[328] For the reasons stated in section IV, this consideration is of obvious relevance to the use of wearable technologies, which could be protected from regulation on free speech grounds.

Industry self-regulation in this space can take the form of what is known as *privacy by design* and *security by design*.[329] These terms generally refer to efforts by developers to "bake in" certain privacy and security practices and protections as they are designing and deploying new technologies.[330] The Future of Privacy Forum has compiled a centralized resource of current standards and best practices to help firms address a wide variety of privacy concerns (e.g., app development, children's privacy, locational privacy and mobile services, and online ads)[331] and has also developed a blueprint to help organizations conduct privacy impact assessments for data-oriented innovations.[332] The Council of Better Business Bureaus has also produced detailed best-practice guidelines for data security[333] and data privacy for small businesses.[334] Finally,

---

[327] *Id.*
[328] *Id.*
[329] ANN CAVOUKIAN, PRIVACY BY DESIGN AND THE EMERGING PERSONAL DATA ECOSYSTEM (Oct. 2012), *available at* http://www.ipc.on.ca/images/Resources/pbd-pde.pdf.
[330] Transatlantic Computing Continuum Policy Alliance, *supra* note 249, at 4 ("These context-specific [privacy and security] choices are something engineers, working alongside privacy and security professionals, can help bake into products."). Efforts aimed at "baking in" security best practices have been under way for many years. *See* Heather Havenstein, *Baked-In Security*, COMPUTERWORLD (Mar. 21, 2005), http://www.computerworld.com/s/article/100443/Baked_In_Security.
[331] *See* Future of Privacy Forum, *Best Practices*, http://www.futureofprivacy.org/resources/best-practices (last visited Oct. 31, 2014).
[332] Jules Polonetsky, Omer Tene & Joseph Jerome, Future of Privacy Forum, *Cost-Benefit Analysis for Big Data Projects* (Sept. 2014), http://www.futureofprivacy.org/wp-content/uploads/FPF_DataBenefitAnalysis_FINAL.pdf.
[333] Council of Better Business Bureaus, *Data Security: Made Simpler*, http://www.bbb.org/data-security (last visited Oct. 31, 2014).
[334] Council of Better Business Bureaus, *Data Privacy for Small Businesses*, http://www.bbb.org/council/for-businesses/toolkits/data-privacy-for-small-businesses (last visited Oct. 31, 2014).

privacy expert Daniel Solove created TeachPrivacy, an educational resource to help train employees about privacy and data security matters.[335]

What do privacy and security by design entail? There are several practical steps that developers of IoT and wearable technologies can take, including the following:

- **Proper use guidelines:** Developers should include clear warnings in their packaging materials that explain to new owners the dangers associated with inappropriate use of their technologies. Many of them already do so.
- **Transparency:** Giving consumers more and better information about their digital tools is one of the key objectives of best practice efforts.[336] "Transparency is crucial," argues FTC Chairwoman Edith Ramirez. "As more and more of our devices become smarter and smarter, it is essential we know as much about them as they know about us—that we understand what information the devices are collecting and how it is being used or shared."[337] Her colleague, FTC Commissioner Julie Brill, argues, "Manufacturers should deploy signals or consumer-friendly online dashboards that explain—through sounds, pictures, or graphs—the data the device collects about consumers, the uses of the data, and who else might see it."[338] On their websites, developers should also clearly disclose how the data their devices collect are retained, if at all, by the company, or who else such data might be shared with, if anyone.

---

[335] *See* TeachPrivacy, http://www.teachprivacy.com (last visited Oct. 31, 2014).
[336] Future of Privacy Forum, *supra* note 192, at 13 ("Transparency can also be vital to the development of the Internet of Things. Industry must ensure that consumers understand how they will benefit from the Internet of Things and see that measures are in place to promote consumer privacy and security.").
[337] Ramirez, *supra* note 231, at 4.
[338] Julie Brill, *Weaving a Tapestry to Protect Privacy and Competition in the Age of Big Data*, presentation to the European Data Protection Supervisor's Workshop on Privacy, Consumer Protection and Competition in the Digital Age (June 2, 2014), at 8, *available at* http://www.ftc.gov/system/files/documents/public_statements/313311/140602edpsbrill.pdf.

- **Data transfer or data minimization:** Developers should also make it easier to transfer or delete data when users so request. Developers should also look to minimize or delete unnecessary datasets that could open future privacy or security vulnerabilities.
- **Ongoing security notices and updates:** Ongoing software updates will be essential to ensure that vulnerabilities are patched as quickly as possible so that IoT does not become "the hacker's new playground."[339]
- **Better security through encryption:** Encryption, anonymization, and data *de-identification*[340]—a term that refers to "storing and sharing the data without revealing the identity of the individuals involved"— will also be important, even if imperfect.[341]

Why would developers adopt such best practices or codes of conduct voluntarily? Fear of legal liability and pressure from government officials are two possible explanations. But, in most cases, it comes down to good business. Many potential customers will care deeply about the privacy and security of their IoT and wearable devices and services.[342] "The signs are already beginning to appear," says Ann Cavoukian—who is widely credited with coining the term

[339] Arik Hesseldahl, *The Internet of Things Is the Hackers' New Playground*, RE/CODE (July 29, 2014), http://recode.net/2014/07/29/the-internet-of-things-is-the-hackers-new-playground/.
[340] ANN CAVOUKIAN & DANIEL CASTRO, SETTING THE RECORD STRAIGHT: DE-IDENTIFICATION DOES WORK (June 16, 2014), *available at* http://www2.itif.org/2014-big-data-deidentification.pdf.
[341] Daniel C. Barth-Jones, *Does De-identification Work or Not?*, FIERCE BIG DATA (June 23, 2014), http://www.fiercebigdata.com/node/35502156; Arvind Narayanan & Edward W. Felten, *No Silver Bullet: De-identification Still Doesn't Work*, RANDOMWALKER (July 9, 2014), http://randomwalker.info/publications/no-silver-bullet-de-identification.pdf.
[342] *The Internet of Things (To Be Hacked)*, ECONOMIST, July 10, 2014, *available at* http://www.economist.com/news/leaders/21606829-hooking-up-gadgets-web-promises-huge-benefits-security-must-not-be ("Wrongdoers should be punished, but the best prompt for securing the internet of things is competition. Either tech firms will find ways to make web-connected gadgets more dependable, or people will decide they can live without them."). *See also* Larry Magid, *Safety, Security and Privacy Risks of Fitness Tracking and "Quantified Self,"* FORBES (July 31, 2014), http://www.forbes.com/sites/larrymagid/2014/07/31/safety-security-and-privacy-risks-of-fitness-tracking-and-quantified-self.

privacy by design—that "market leaders are embracing *Privacy by Design*, and are, in turn, reaping the benefits."[343]

The last thing that developers want on their hands is consumer backlash or unwanted press attention because of failures related to privacy or data security.[344] Such failures could have profound consequences. "Not only should privacy protection be built in from the start, it also has to be communicated effectively to all stakeholders throughout the process," says David Hoffman, director of Intel's Security Policy and Global Privacy Office.[345] "Failure to do so may incur financial implications," he believes.

In essence, self-regulation comes down to organizations' being good stewards of the information they gather and use.[346] Wittes and Bennett argue that this is "a relationship best seen as a form of trusteeship."[347]

> A user's entrusting his or her personal data to a company in exchange for a service, we shall argue, conveys certain obligations to the corporate custodians of that person's data: obligations to keep it secure, obligations to be candid and straightforward with users about how their data is being exploited, obligations not to materially misrepresent their uses of user data, and obligations not to use them in fashions injurious to or materially adverse to the users' interests without their explicit consent. These obligations show up in nearly all privacy codes, in patterns of government enforcement, and in the privacy policies of the largest internet companies.[348]

The rise of privacy and security professionals is having an important influence on how privacy and security by design work in practice today. Privacy professionals come in many

---

[343] Ann Cavoukian, *2011: The Decade of Privacy by Design Starts Now*, ITBUSINESS (Jan. 15, 2011), http://blogs.itbusiness.ca/2011/01/2011-the-decade-of-privacy-by-design-starts-now.

[344] Danny Yadron, *Corporate Boards Race to Shore Up Cybersecurity*, WALL ST. J., June 29, 2014, *available at* http://online.wsj.com/articles/boards-race-to-bolster-cybersecurity-1404086146.

[345] *Quoted in* Tom Quillin, *Why Is Privacy Important to Security Practitioners & Professionals?*, INFORMATIONWEEK DARK READING (May 23, 2014), http://www.darkreading.com/why-is-privacy-important-to-security-practitioners-and-professionals/a/d-id/1269187?.

[346] Letter from Ken Wasch, *supra* note 196, at 8 ("[T]o maximize the opportunities presented by the Internet of Things and data-driven innovation, policies should take a more practical approach, shifting responsibility away from data subjects toward data users, and increasing the emphasis on responsible data stewardship and accountability.")

[347] Wittes & Bennett, *supra* note 230, at 2.

[348] *Id.*

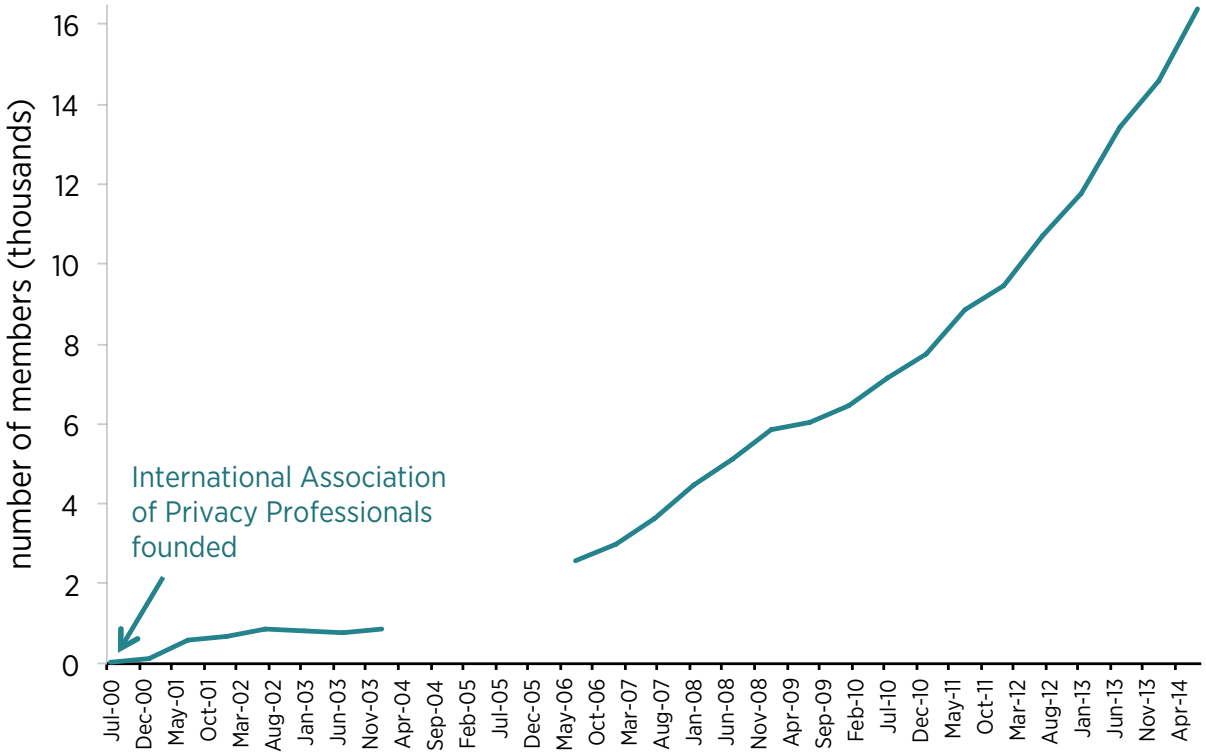
flavors, with titles such as chief privacy officer, chief information officer, chief data officer, data architect, and data ethicist.[349] Daniel Solove notes that these privacy professionals "educate personnel to be mindful of privacy and influence software, product, and service design to be more privacy friendly. Privacy self-management thus has the salutary effect of creating beneficial structural privacy protections and accountability inside institutions."[350] Nothing better illustrates the growing role that these privacy professionals play today than the swelling membership ranks of the International Association of Privacy Professionals (IAPP), which trains and certifies privacy professionals. Membership in the IAPP, which was founded in 2000, grew to more than 15,000 by the end of 2013, up from 10,000 in March 2012 (figure 2).[351]

The reason all this activity by privacy professionals is so important is that, as Berkeley Law School professors Kenneth A. Bamberger and Deirdre K. Mulligan note, it is increasingly what happens "on the ground"—that is, the day-to-day management of privacy decisions through the interaction of privacy professionals, engineers, outside experts, and regular users—that is perhaps most important for protecting consumers' privacy.[352] They suggest that "governing privacy through flexible principles" may be optimal, or at least more feasible, when compared to other regulatory efforts.[353] As more technology firms bring on privacy and security professionals, this process of "baking in" best practices becomes more routine, and compliance becomes easier over time.

---

[349] *See* Brad Peters, *Meet the CDO*, FORBES (Dec. 20, 2013), http://www.forbes.com/sites/bradpeters/2013/12/20/meet-the-cdo.
[350] Solove, *supra* note 253, at 1900.
[351] Omer Tene, *2013: The Year of Privacy*, PRIVACY PERSPECTIVES (Dec. 19, 2013), https://privacyassociation.org/news/a/2013-the-year-of-privacy-2/.
[352] Kenneth A. Bamberger & Deirdre K. Mulligan, *Privacy on the Books and on the Ground*, 63 STAN. L. REV. 247 (2011).
[353] *Id.* at 253.

Figure 2. The Explosion of Privacy Professionals: International Association of Privacy Professionals Membership, 2000–2014



Source: International Association of Privacy Professionals.

Note: Data for 2004 and 2005 are unavailable.

Of course, as the FTC's Ohlhausen also observes, "self-regulation is not a perfect solution, nor can it be a complete substitute for traditional regulation." She argues that "it's important that self-regulation is backed up by enforcement. If a company makes a promise publicly and it doesn't adhere to that, we can bring an enforcement action."[354] In this regard, the FTC's important regulatory backstop role will be discussed later in this paper.

Regardless of whether they will be enforced internally by firms or by ex post FTC enforcement actions, best practices must not become a heavy-handed, quasi-regulatory straitjacket. A focus on security and privacy by design does not mean those are the only values

[354] *Quoted in* Bracy, *supra* note 324.

and design principles that developers should focus on when innovating. Cost, convenience, choice, and usability are all important values too. In fact, many consumers will prioritize those values over privacy and security—even as activists, academics, and policymakers simultaneously suggest that more should be done to address privacy and security concerns.

Finally, best practices for privacy and security issues will need to evolve as social acceptance of various technologies and business practices evolve. For example, had "privacy by design" been interpreted strictly when wireless geolocation capabilities were first being developed, these technologies might have been shunned because of the privacy concerns they raised. With time, however, geolocation technologies have become a better understood and more widely accepted capability that consumers have come to expect will be embedded in many of their digital devices.[355] Those geolocation capabilities enable services that consumers now take for granted, such as instantaneous mapping services and real-time traffic updates.

This is why flexibility is crucial when interpreting the privacy and security best practices.

C. Empowerment Solutions

Although IoT innovation is occurring at a breakneck pace, it may nonetheless be possible that technological self-help solutions will emerge to help individuals and organizations better protect their privacy and security.[356] More robust, end-to-end encryption will certainly be a major part of the solution. As Gershenfeld and Vasseur conclude,

> privacy can be protected on the Internet of Things. Today, privacy on the rest of the Internet is safeguarded through cryptography, and it works: recent mass thefts of personal information have happened because firms failed to encrypt their customers' data, not because the hackers broke through strong protections. By extending cryptography down

[355] *See* Bambauer, *supra* note 227, at 238.
[356] Kashmir Hill, *Forget Glass: Here Are Wearables That Protect Your Privacy*, FORBES (July 29, 2014), http://www.forbes.com/sites/kashmirhill/2014/07/29/forget-glass-here-are-wearables-that-protect-your-privacy.

> to the level of individual devices, the owners of those devices would gain a new kind of control over their personal information. Rather than maintaining secrecy as an absolute good, it could be priced based on the value of sharing. Users could set up a firewall to keep private the Internet traffic coming from the things in their homes—or they could share that data with, for example, a utility that gave a discount for their operating their dishwasher only during off-peak hours or a health insurance provider that offered lower rates in return for their making healthier lifestyle choices.[357]

Other creative solutions will likely emerge as problems develop. Roger A. Grimes, a security expert with Microsoft, argues that "what we need is device identity. In order for us to begin securing IoT, we have to be able to reliably authenticate devices and apply the appropriate security controls to those devices—and be able to identify misbehaving devices and remediate them."[358] "The real way to decrease Internet crime is to make it harder for the bad guys to get away with malicious hacking. Once the bad guys realize that they're likely to get caught—and those who get away with it don't make much money—Internet crime will decrease," he argues.[359]

Better device authentication mechanisms could help address this. Computer scientists at the University of California, San Diego, recently announced the development of a tool that "tags critical pieces in a hardware's security system and tracks them."[360] This tool will help IoT developers and users detect security vulnerabilities that can compromise a device's security and address them before problems develop. "IoT isn't a frightening giant ogre," argues security consultant Jim O'Reilly. "If we stop admiring how big it is and realize the devil is in the details, we should be able to handle IoT just fine."[361]

---

[357] Gershenfeld & Vasseur, *supra* note 16.
[358] Roger A. Grimes, *The Right Way to Secure the Internet of Things*, INFOWORLD (Apr. 15, 2014), http://www.infoworld.com/d/security/the-right-way-secure-the-internet-of-things-240486.
[359] *Id.*
[360] *Computer Scientists Develop Tool to Make the Internet of Things Safer*, PHYS.ORG (June 2, 2014), http://phys.org/news/2014-06-scientists-tool-internet-safer.html#jCp.
[361] Jim O'Reilly, *The Internet of Things: Not So Scary*, INFORMATION WEEK NETWORK COMPUTING (May 23, 2014), http://www.networkcomputing.com/wireless-infrastructure/the-internet-of-things-not-so-scary/a/d-id/1269152?.

An extensive array of privacy-enhancing technologies and consumer information is already available on the market today to help users block or limit data collection or help them achieve a more anonymous browsing experience.[362] Some of those tools can help users protect their privacy as they start using more IoT and wearable technologies.

Other technological empowerment fixes will emerge spontaneously to address new IoT-related challenges as they develop. For example, *Wired* recently profiled a Berlin artist who wrote a simple program to detect any Google Glass device attempting to connect to a Wi-Fi network and alert those in the area that someone is using Glass nearby. The program could even send a "deauthorization" command, cutting the Wi-Fi connection for the headset.[363]

As noted next, firms have a powerful incentive to handle security concerns preemptively to avoid liability and negative press attention down the road. Industry consortia can help achieve security in a more collective fashion through best practices. For example, in early 2014, the Industrial Internet Consortium was established "to further development, adoption, and wide-spread use of interconnected machines, intelligent analytics, and people at work," and "build confidence around new and innovative approaches to security."[364] Founding members include AT&T, Cisco, IBM, Intel, and General Electric. As firms investigate and establish innovative approaches to security in web-connected industrial gear, eventually those best practices will be applied to consumer devices and systems as well.[365]

---

[362] *See* Thierer, *supra* note 228, at 440–46.
[363] Andy Greenberg, *Cut Off Glassholes' Wi-Fi with This Google Glass Detector*, WIRED (June 3, 2014), http://www.wired.com/2014/06/find-and-ban-glassholes-with-this-artists-google-glass-detector.
[364] *The Industrial Internet Consortium: A Nonprofit Partnership of Industry, Government and Academia*, INDUSTRIAL INTERNET CONSORTIUM, http://www.iiconsortium.org/about-us.htm (last visited July 14, 2014).
[365] *Prevention Is Better Than Cure*, ECONOMIST, July 10, 2014, *available at* http://www.economist.com/news/special-report/21606424-more-vigilance-and-better-defences-can-make-cyberspace-lot-safer-prevention-better.

D. Common-Law Solutions, Evolving Liability Standards, and Other Legal Recourses

Torts and other legal mechanisms will also continue to play a role in protecting privacy and data security.[366] Privacy torts evolved fairly recently compared to other common-law torts, but it is probable that—like other torts—they will continue to evolve in response to technological change and provide more avenues of recourse to plaintiffs seeking to protect their privacy rights.[367] The four privacy torts are public disclosure of private facts, intrusion upon seclusion, false light, and appropriation of name or likeness.

The tort of intrusion upon seclusion may evolve in response to some of the specific technological changes outlined in this paper and in the process provide additional remedies to perceived privacy harms.[368] This tort states, "One who intentionally intrudes, physically or otherwise, upon the solitude or seclusion of another or his private affairs or concerns, is subject to liability to the other for invasion of his privacy, if the intrusion would be highly offensive to a reasonable person."[369] Cases flowing from this tort have dealt with "involuntary exposure in public"[370] and "overzealous surveillance"[371] activities, as well as entering a person's home under false pretenses and recording their activities.[372] It would not be surprising to see future privacy-related controversies give rise to more legal actions involving the tort of intrusion upon seclusion

[366] *See* Harper, *supra* note 259.
[367] Bambauer, *supra* note 227, at 273 ("Tort law holds the solution to vexing problems in privacy law. Yet it has been neglected by privacy law scholars, who are on a misguided quest to constrain the quantity, spread, and repurposing of personal data. The extensive regulations they propose come into direct conflict with traditional American normative commitments to the free flow of information.").
[368] *See Id.*
[369] RESTATEMENT (SECOND) OF TORTS §§ 652B (1977).
[370] Daily Times Democrat v. Graham, 276 Ala. 380 (1964).
[371] Nader v. General Motors Corp., 25 N.Y. 2d 560 (1970).
[372] Dietemann v. Time, Inc., 449 F.2d 245 (9th Cir. 1971).

because, as Bambauer notes, it "offers the best theory to target legitimate privacy harms in the information age."[373]

Other federal and state laws already exist that could address privacy concerns.[374] Property law already addresses trespass, and future court rulings could see property norms extended to cover new types of harms involving wearable technologies.[375] State Peeping Tom laws that prohibit peering into individual homes or even surreptitious spying in public also exist.[376] The Video Voyeurism Prevention Act imposes fines and even jail time on those who have an "intent to capture an image of a private area of an individual without their consent, and knowingly does so under circumstances in which the individual has a reasonable expectation of privacy."[377] The Fair Credit Reporting Act also already offers consumers access and correction remedies for their credit records, and its provisions may apply to some of the records created through new IoT technologies.[378]

Contract law can also act as a powerful deterrent to the misuse of IoT and wearable technologies, not only in the workplace, but in many other formal relationships. State officials—state attorneys general in particular—also continue to push for new policies addressing privacy and data security, many of which are often more stringent than federal law.[379]

---

[373] Bambauer, *supra* note 227, at 205 ("The tort of intrusion upon seclusion offers the best theory to target legitimate privacy harms in the information age.").
[374] Micah Singleton, *Defining Privacy in the Age of Wearable Cameras*, KERNEL (Sept. 14, 2014), http://kernelmag .dailydot.com/issue-sections/features-issue-sections/10248/glass-wearable-cameras-legal-privacy ("Perhaps, though, instead of a surge of new laws, we may witness current laws against recording people without consent enforced more actively, as wearables continue to get smaller and more advanced.").
[375] Harper, *supra* note 259, at 3 ("Real property law and the law of trespass mean that people have legal backing when they retreat into their homes, close their doors, and pull their curtains to prevent others from seeing what goes on within.").
[376] *See, e.g.*, Va. Code Ann. § 18.2-130 Peeping or spying into dwelling or enclosure.
[377] Video Voyeurism Prevention Act, 18 U.S.C. § 1801 (2006).
[378] Fair Credit Reporting Act, 15 U.S.C. § 1681, *available at* http://www.ftc.gov/os/statutes/031224fcra.pdf.
[379] Christopher Wolf, *Targeted Enforcement and Shared Lawmaking Authority as Catalysts for Data Protection*, PRIVACY & SECURITY LAW REPORT 3 (Bureau of Nat'l Affairs, 2010), *available at* http://www.hldataprotection .com/uploads/file/PDFArtic.pdf ("At the state level, legislatures have become the proving grounds for new statutory approaches to privacy regulation. Some of these developments include the enactment of data security breach

Ironically, the fact that IoT and wearable technology developers may be collecting massive volumes of new data could open those developers up to new forms of liability. In the context of intelligent vehicle technology, for example, Bryant Walker Smith of Stanford Law School notes that liability norms will likely be affected by the level of knowledge and control that manufacturers have over those systems.[380] "A seller who can, does, or should know more about the products it sells may be expected to foresee a wider range of product-related uses, misuses, and harms," he argues.[381] In other words, as IoT and wearable technology application developers come to possess a greater volume of data about what users are doing with their devices and services, liability could expand over time for those developers.[382] These developers could become what economists refer to as the "least cost avoider" or the party who is in the best position to minimize risk at the lowest cost.[383] Smith refers to this as "proximity-driven liability."[384]

This observation will likely also be true for other smart systems as new legal standards and responsibilities evolve gradually through a body of common-law cases, as they have for many other technologies. Brookings Institution scholar John Villasenor notes that "when confronted with new, often complex, questions involving products liability, courts have generally gotten things right . . . . Products liability law has been highly adaptive to the many new

---

notification laws . . . as well as highly detailed data security laws, enacted largely in response to data breaches. This partnership has resulted in a set of robust standards for the protection of personal data.").

[380] Bryant Walker Smith, *Proximity-Driven Liability*, 102 GEO. L. J. 1777 (2014), *available at* http://georgetownlaw journal.org/files/2014/08/Smith-Proximity1.pdf.

[381] *Id.*

[382] *Id.* at 1799 ("Since a product use or misuse that should be known to the seller is likely to be foreseeable, this information can also expand the content of other duties.").

[383] STEVEN SHAVELL, FOUNDATIONS OF ECONOMIC ANALYSIS OF LAW 189 (2004).

[384] Smith, *supra* note 380.

technologies that have emerged in recent decades, and it will be quite capable of adapting to emerging autonomous vehicle technologies as the need arises."[385]

Thus, instead of trying to micromanage the development of IoT technologies in an attempt to plan for every hypothetical risk scenario, policymakers should be patient while the common law evolves and liability norms adjust.[386] Traditionally, the common law has dealt with products liability and accident compensation in an evolutionary way through a variety of mechanisms, including strict liability, negligence, design defects law, failure to warn, and breach of warranty.[387] There is no reason to think that the common law will not adapt to new technological realities, including IoT and wearable technologies, especially since firms have powerful incentives to improve the security of their systems and avoid punishing liability, unwanted press attention, and lost customers.[388]

E. Federal Trade Commission Oversight and Enforcement

The FTC has already played a major role in addressing concerns about privacy and security for today's leading online technologies. The agency has used its broad authority under section 5 of

---

[385] John Villasenor, *Who Is at Fault When a Driverless Car Gets in an Accident?*, ATLANTIC (Apr. 25, 2014), http://www.theatlantic.com/business/archive/2014/04/who-is-at-fault-when-a-driverless-car-gets-in-an-accident/361250.

[386] *The Internet of Things (To Be Hacked)*, *supra* note 342 ("[Governments] should make clear that web-connected gadgets are covered by existing safety laws and existing product-liability regimes.").

[387] John Villasenor, *Products Liability and Driverless Cars: Issues and Guiding Principles for Legislation*, CENTER FOR TECHNOLOGY INNOVATION RESEARCH PAPER (Brookings Institution), Apr. 24, 2014, at 7–14, *available at* http://www.brookings.edu/research/papers/2014/04/products-liability-driverless-cars-villasenor.

[388] Eli Dourado, *Internet Security Without Law: How Service Providers Create Order Online* (Mercatus Center at George Mason University, Working Paper 12-19, 2012), *available at* http://mercatus.org/publication/internet-security-without-law-how-service-providers-create-order-online; U.S. Chamber of Commerce, cmt. to the Fed. Trade Comm'n on Internet of Things, Project No. P135405 (Jan. 10, 2014), at 3, http://www.ftc.gov/sites/default/files/documents/public_comments/2014/01/00011-88248.pdf ("In this tough economy, businesses depend more than ever on having beneficial and trusted relationships with their customers. Successful companies work to ensure that their products and services are deemed trustworthy by their customers. If a company has failed to meet customers' privacy and security expectations, then oftentimes the marketplace and public relations consequences will be swift and decisive, forcing the company to quickly align its business practices with consumer expectations.").

the Federal Trade Commission Act, which prohibits "unfair or deceptive acts or practices in or affecting commerce."[389] Section 5 gives the FTC remarkably broad authority to address alleged violations of data privacy and security standards. Bamberger and Mulligan note that "since 1996 the FTC has actively used its broad authority under section 5 . . . to take an active role in the governance of privacy protection, ranging from issuing guidance regarding appropriate practices for protecting personal consumer information, to bringing enforcement actions challenging information practices alleged to cause consumer injury."[390]

In recent years, for example, the FTC has brought privacy-related and data-security-oriented enforcement actions against a wide variety of information technology companies, including Google,[391] Facebook,[392] Apple,[393] Twitter,[394] MySpace,[395] HTC,[396] Lookout,[397] Path,[398] Snapchat,[399] Fandango,[400] and Credit Karma,[401] among many others.[402] In testimony delivered in

[389] 15 U.S.C. § 45(a) (2006).
[390] Bamberger & Mulligan, *supra* note 352, at 273.
[391] *In the Matter of Google Inc*., Fed.Trade Comm'n (Oct. 24, 2011), http://www.ftc.gov/enforcement/cases-proceedings/102-3136/google-inc-matter; Alex Howard, *Google Reaches Agreement with FTC on Buzz Privacy Concerns*, GOVFRESH (Mar. 30, 2011), http://gov20.govfresh.com/google-reaches-agreement-with-ftc-on-buzz-privacy-concerns.
[392] *In the Matter of Facebook, Inc*., Fed.Trade Comm'n (Aug. 10, 2012), http://www.ftc.gov/enforcement/cases-proceedings/092-3184/facebook-inc; Brent Kendall, *Facebook Reaches Settlement with FTC on Privacy Issues*, WALL ST. J., Nov. 29, 2011, *available at* http://online.wsj.com/article/BT-CO-20111129-710865.html.
[393] Press Release, Fed.Trade Comm'n, *Apple Inc. Will Provide Full Consumer Refunds of at Least $32.5 Million to Settle FTC Complaint It Charged for Kids' In-App Purchases Without Parental Consent* (Jan. 15, 2014), *available at* http://www.ftc.gov/news-events/press-releases/2014/01/apple-inc-will-provide-full-consumer-refunds-least-325-million.
[394] *In the Matter of Twitter, Inc.*, Fed.Trade Comm'n (Mar. 11, 2011), http://www.ftc.gov/enforcement/cases-proceedings/092-3093/twitter-inc-corporation.
[395] *In the Matter of Myspace LLC*, Fed.Trade Comm'n (Sept. 11, 2012), http://www.ftc.gov/enforcement/cases-proceedings/102-3058/myspace-llc-matter.
[396] *In the Matter of HTC America Inc*., Fed.Trade Comm'n (July 2, 2013), http://www.ftc.gov/enforcement/cases-proceedings/122-3049/htc-america-inc-matter.
[397] *In the Matter of Lookout Services, Inc.*, Fed.Trade Comm'n (June 15, 2011), http://www.ftc.gov/enforcement/cases-proceedings/102-3076/lookout-services-inc-matter.
[398] *Path, Inc.*, Fed.Trade Comm'n (Feb. 1, 2013), http://www.ftc.gov/enforcement/cases-proceedings/122-3158/path-inc.
[399] *In the Matter of Snapchat, Inc.*, Fed.Trade Comm'n (May 14, 2014), http://www.ftc.gov/enforcement/cases-proceedings/132-3078/snapchat-inc-matter.
[400] *In the Matter of Fandango, LLC*, Fed.Trade Comm'n (Mar. 28, 2014), http://www.ftc.gov/enforcement/cases-proceedings/132-3089/fandango-llc.

May 2014, an FTC official noted that it had pursued 53 data-security-related cases, which "examined a company's practices as a whole and challenged alleged data security failures that were multiple and systemic."[403]

Companies fear such FTC enforcement actions because they can bind a company to lengthy, twenty-year privacy audits[404] and open it up to potential liability of up to $16,000 per customer harmed per violation.[405] Moreover, firms take a reputation hit with the press and the general public when such enforcement actions are handed down.

Leading privacy scholars have argued that "the principles that emerge from FTC privacy 'common law' [demonstrate] that the FTC's privacy jurisprudence is quite thick."[406] At a minimum, these enforcement actions make it clear that the agency already possesses plenary authority under section 5 to "make sure companies live up to the privacy promises they make to consumers."[407]

The agency has also released industry best-practice guidance for mobile app data collection and privacy practices,[408] digital advertising disclosures,[409] facial recognition

---

[401] *In the Matter of Credit Karma, Inc.*, Fed.Trade Comm'n (Mar. 28, 2014), http://www.ftc.gov/enforcement/cases-proceedings/132-3091/credit-karma-inc.
[402] *See* Daniel J. Solove & Woodrow Hartzog, *The FTC and the New Common Law of Privacy*, 114 COLUM. L. REV. 538 (2014), *available at* http://columbialawreview.org/wp-content/uploads/2014/04/Solove-Hartzog.pdf.
[403] Maneesha Mithal, *Prepared Statement of the Federal Trade Commission on Emerging Threats in the Online Advertising Industry Before the Committee on Homeland Security and Governmental Affairs Permanent Subcommittee on Investigations, U.S. Senate* 12 (May 15, 2014), http://www.ftc.gov/system/files/documents/public_statements/309891/140515emergingthreatsonline.pdf.
[404] Kashmir Hill, *So, What Are These Privacy Audits That Google and Facebook Have to Do for the Next 20 Years?*, FORBES (Nov. 30, 2011), http://www.forbes.com/sites/kashmirhill/2011/11/30/so-what-are-these-privacy-audits-that-google-and-facebook-have-to-do-for-the-next-20-years.
[405] Daniel J. Solove & Woodrow Hartzog, *The Anatomy of an FTC Privacy and Data Security Consent Order*, LINKEDIN (May 12, 2014), https://www.linkedin.com/today/post/article/20140512053224-2259773-the-anatomy-of-an-ftc-privacy-and-data-security-consent-order.
[406] Solove & Hartzog, *supra* note 402, at 583. *See also* Wolf, *supra* note 379, at 3.
[407] Press Release, Fed.Trade Comm'n, Path Social Networking App Settles FTC Charges It Deceived Consumers and Improperly Collected Personal Information from Users' Mobile Address Books (Feb. 1, 2013), *available at* http://www.ftc.gov/news-events/press-releases/2013/02/path-social-networking-app-settles-ftc-charges-it-deceived.
[408] *FTC Publishes Guide to Help Mobile App Developers Observe Truth-in-Advertising, Privacy Principles*, FED. TRADE COMM'N (Sept. 5, 2012), http://www.ftc.gov/opa/2012/09/mobileapps.shtm.

technologies,[410] and other things that may be relevant to IoT and wearable technologies. It is likely that the agency will continue to actively monitor this marketplace to ensure that privacy and data security remain top priorities.[411] In fact, the FTC has already brought an enforcement action against TRENDnet, a maker of Internet-connected home video cameras, for "lax security practices [that] exposed the private lives of hundreds of consumers to public viewing on the Internet."[412]

Importantly, however, the FTC has acknowledged limits to its enforcement powers. "Through these settlements, the Commission has made clear that reasonable and appropriate security is a continuous process of assessing and addressing risks; that there is no one-size-fits-all data security program; that the Commission does not require perfect security; and that the mere fact that a breach occurred does not mean that a company has violated the law."[413] Such enforcement constraint and flexibility will be essential if IoT and wearable technologies are to realize their full potential.

F. Social Norms, Pressure, and Sanctions

Norms—"social attitudes of approval and disapproval, specifying what ought to be done and what ought not to be done"[414]—can play a powerful role in curbing potentially problematic

---

[409] FED. TRADE COMM'N, .COM DISCLOSURES: HOW TO MAKE EFFECTIVE DISCLOSURES IN DIGITAL ADVERTISING 16 (2013), *available at* http://www.ftc.gov/os/2013/03/130312dotcomdisclosures.pdf.
[410] Press Release, Fed. Trade Comm'n, *FTC Recommends Best Practices for Companies That Use Facial Recognition Technologies* (Oct. 22, 2012), *available at* http://www.ftc.gov/opa/2012/10/facialrecognition.shtm.
[411] *FTC Enters "Internet of Things" Arena with TRENDnet Proposed Settlement*, INFORMATION LAW GROUP (Sept. 9, 2013), http://www.infolawgroup.com/2013/09/articles/ftc/trendnet-settlement.
[412] Press Release, Fed. Trade Comm'n, *Marketer of Internet-Connected Home Security Video Cameras Settles FTC Charges It Failed to Protect Consumers' Privacy* (Sept. 4, 2014), http://www.ftc.gov/news-events/press-releases/2013/09/marketer-internet-connected-home-security-video-cameras-settles.
[413] Mithal, *supra* note 403.
[414] Cass Sunstein, *Social Norms and Social Roles*, 96 COLUM. L. REV. 903, 914 (1996).

behavior by both the developers of IoT and its users. Indeed, the power of social norms in this context could become a crucial determinant of the popularity of many wearable technologies.

Sometimes cultural norms, public pressure, and spontaneous social sanctions form a far more powerful "regulator" of innovations and how people use new tools than do laws and regulations.[415] Cristina Bicchieri, a leading behavioral ethicist, calls social norms "the grammar of society" because,

> like a collection of linguistic rules that are implicit in a language and define it, social norms are implicit in the operations of a society and make it what it is. Like a grammar, a system of norms specifies what is acceptable and what is not in a social group. And analogously to a grammar, a system of norms is not the product of human design and planning.[416]

Indeed, social pressure and constraints on the use and misuse of technology often develop in an organic, bottom-up fashion. For example, social norms continue to evolve to deal with smartphone usage in various environments, such as in some restaurants, most movie theaters, and gym locker rooms, where their use is frowned upon or actively discouraged. In some cases, social norms and constraints take the form of formal restrictions imposed by establishments themselves. Other times, however, social pressure develops more spontaneously from other people in the vicinity. For example, theaters use preshow messaging to pressure patrons to mute or turn off electronic devices, but other moviegoers are equally likely to make their displeasure with interruptions known to offending parties. Likewise, some passenger trains include "quiet cars," where phone conversations are prohibited, and other riders often scold passengers who ignore those rules.[417] Finally, while fitness centers often post signs disallowing the use of

---

[415] THIERER, *supra* note 7, at 57–58.
[416] CRISTINA BICCHIERI, THE GRAMMAR OF SOCIETY: THE NATURE AND DYNAMICS OF SOCIAL NORMS ix (2006).
[417] Vincent M. Mallozzi, *On Train, a Fight Between Silent and Merely Quiet*, N.Y. TIMES, Jan. 9, 2011, *available at* http://www.nytimes.com/2011/01/10/nyregion/10quiet.html.

smartphones in locker rooms, anyone attempting to use them to take pictures would likely quickly meet the wrath of offended patrons.

In a similar way, it is likely that social norms and pressures will influence the development and use of wearable computing technologies, such as Google Glass and other wearable devices.[418] "I can imagine social norms emerging on when it's appropriate to wear a camera, and when it isn't appropriate," says privacy lawyer Kurt Wimmer.[419] Advice columns are already being written about "Google Glass etiquette." Their recommendations include taking Google Glass off when first meeting someone; removing it immediately when others seem uncomfortable; and never wearing it in bathrooms or other highly private settings.[420]

More forceful opposition to Google Glass and other wearable computing or recording devices may develop in the future. Stop the Cyborgs is an advocacy group that offers various resources to push back against these technologies, including free downloadable "Google Glass ban signs" that can be displayed in places where such technologies may not be welcome.[421] The group also offers stickers and shirts that convey the same message.

In the extreme, social sanction can sometimes even involve violence or the threat thereof. For example, in February 2014, a woman who wore Google Glass into a San Francisco bar was verbally and physically assaulted by a man who was upset about potentially having his privacy

---

[418] Jared Newman, *The Real Privacy Implications of Google Glass*, TIME TECH, May 2, 2013, *available at* http://techland.time.com/2013/05/02/the-real-privacy-implications-of-google-glass.

[419] *Quoted in* Singleton, *supra* note 374.

[420] Kevin Sintumuang, *Google Glass: An Etiquette Guide*, WALL ST. J., May 3, 2013, *available at* http://online.wsj.com/article/SB10001424127887323982704578453031054200120.html; Rebecca Greenfield, *The First Rule of Google Glass Etiquette*, WIRE (May 6, 2013), http://www.theatlanticwire.com/technology/2013/05/google-glass-etiquette/64916; Ryan Singel, *Devising a Personal Google Glass Privacy Policy*, MEDIUM (May 13, 2013), https://medium.com/future-participle/2334fecda87e; Jedidiah Bracy, *Putting Google Glass on Ann Landers*, PRIVACY PERSPECTIVES (Feb. 28, 2014), https://www.privacyassociation.org/privacy_perspectives/post/what_happens_when_ann_landers_puts_on_google_glass.

[421] Stop the Cyborgs, *About*, http://stopthecyborgs.org/about (last visited June 24, 2014).

invaded.[422] It would be extremely unfortunate if tensions over wearable technologies resulted in violent altercations, but these early incidents may have the salubrious side effect of reminding users that not everyone shares their privacy values and that public uses of wearable technologies should be moderated accordingly.[423]

Social norms and pressure can also be applied at the developer level to influence design choices. The behavior of developers of IoT and wearable technology will likely be influenced by the pressure applied by the broad and growing collection of privacy watchdog groups that exist, including the American Civil Liberties Union (ACLU), the Center for Democracy and Technology, the Electronic Frontier Foundation, the Electronic Privacy Information Center, the Future of Privacy Forum, Privacy Rights Clearinghouse, and many others.[424] These advocacy groups have developed websites and materials to better inform consumers about how they can protect their privacy.[425] Such organizations agitate for more rigorous privacy protections incessantly, and privacy policies—both legal enactments and informal corporate standards—will continue to be significantly influenced by the pressure that these advocates exert on the process. Furthermore, there has been an explosion of academic interest in privacy-related matters in recent years, and this too influences developer behavior.

Finally, media attention also plays an important role in curbing potentially problematic behavior—by individuals and developers alike. FTC Chairwoman Ramirez notes that

> media organizations . . . have a vital role to play as well. In recent years, premier news organizations have paid increasing attention to consumer privacy issues, publicizing

[422] Jessica Guynn, *Clash over Google Glass Shows Hurdles Facing Wearable Tech*, L.A. TIMES, Feb. 27, 2014, *available at* http://articles.latimes.com/2014/feb/27/business/la-fi-google-glass-attack-20140228.
[423] Andrew Leonard, *Glasshole Nation: Tech's Culture War Takes Another Ugly Turn*, SALON (Feb. 28, 2014), http://www.salon.com/2014/02/28/glasshole_nation_techs_culture_war_takes_another_ugly_turn.
[424] Thierer, *supra* note 261, at 483–84.
[425] Thierer, *supra* note 228, at 439.

> excesses in some data gathering methods. Such public scrutiny gives firms a powerful incentive to act as responsible stewards of consumer information.[426]

There already exists intense media and blogger interest in the privacy- and security-related implications of IoT and wearable technologies, and that coverage will likely grow as these devices and services multiply.

G. Law Enforcement Guidelines and Restrictions

The use of wearable technologies by law enforcement officials—or law enforcement's ability to tap into private data flow from wearable devices—deserves special scrutiny and additional legal protections for the public. There are significant differences between public and private entities, and policymakers should continue to distinguish between them when considering data collection policies.[427] Private entities cannot fine, tax, or imprison people because they lack the coercive powers that governments possess. Moreover, although it is possible to ignore or refuse to be a part of various private services, the same is not true for governments, whose grasp cannot be evaded. Thus, special protections regarding wearables, IoT devices, and data flows are needed for law enforcement agencies and officials.

The ACLU has developed a set of best practices for law enforcement use of "body cams" or "cop cams," which can be used to record an officer's interactions with the public.[428] The ACLU suggests, among other things, that citizens be notified that they are being recorded, that data "be retained no longer than necessary for the purpose for which it was collected," and

---

[426] Edith Ramirez, Chairwoman, Fed. Trade Comm'n, *Protecting Consumer Privacy in a Big Data Age*, Remarks Before the Media Institute, Washington, D.C. (May 8, 2014), at 11–12, *available at* http://www.ftc.gov/system/files/documents/public_statements/308421/ramirez_-_media_institute_5-8-14.pdf.

[427] Adam Thierer, *Do We Need a Constitutional Amendment Restricting Private-Sector Data Collection?*, PRIVACY PERSPECTIVES (Jan. 23, 2014), https://www.privacyassociation.org/privacy_perspectives/post/do_we_need_a_constitutional_amendment_restricting_private_sector_data_colle.

[428] Adi Robertson, *The ACLU Wants Police Officers to Wear Cameras, but Only with Privacy Protections*, VERGE (Oct. 9, 2013), http://www.theverge.com/2013/10/9/4820600/aclu-issues-guidelines-for-police-officer-cameras.

"that this technology not become a backdoor for any kind of systematic surveillance or tracking of the public."[429]

When government seeks access to privately held data collected from wearables or other IoT technologies, strong constitutional and statutory protections should apply. Privacy advocates fear that "the government will inevitably demand access" to any private data that is collected for commercial purposes,[430] but to the extent that this is a growing problem, those advocates should redouble their efforts to constrain government surveillance powers and the ability to indiscriminately suck up privately held data. Congress should reform the Electronic Communications Privacy Act of 1986 (the primary federal statute that governs when law enforcement agencies may compel private entities to divulge information held on behalf of third-party subscribers) to require the government to obtain a warrant issued upon a showing of probable cause before accessing the privately held data and communications.[431] Also, courts should revisit the "third-party doctrine,"[432] which holds that individuals sacrifice their Fourth Amendment interest in their personal information when they divulge it to a third party, even if that party has promised to safeguard that data.[433] Other bolstered Fourth Amendment constraints on national security and law enforcement powers are also essential.[434] Again, because governments have unique powers and responsibilities, they qualify for a different level of legal scrutiny.

---

[429] Jay Stanley, *Police Body-Mounted Cameras: With Right Policies in Place, a Win for All,* ACLU (Oct. 9, 2013), https://www.aclu.org/technology-and-liberty/police-body-mounted-cameras-right-policies-place-win-all.
[430] Jeffrey Rosen, *Madison's Privacy Blind Spot*, N.Y. TIMES, Jan. 18, 2014, *available at* http://www.nytimes.com /2014/01/19/opinion/sunday/madisons-privacy-blind-spot.html?_r=0.
[431] Charles H. Kennedy, *An ECPA for the 21st Century: The Present Reform Efforts and Beyond*, 20 COMMLAW CONSPECTUS 129 (2011).
[432] Babak Siavoshy, *Need an Alternative to the Third Party Doctrine? Look Backwards, Not Forward (Part I)*, CONCURRING OPINIONS (July 7, 2014), http://www.concurringopinions.com/archives/2014/07/need-an-alternative -to-the-third-party-doctrine-look-backward-not-forward.html.
[433] Jim Harper, *Reforming Fourth Amendment Privacy Doctrine*, 57 AM. U. L. REV., 1381, 1401 (2008), *available at* http://www.wcl.american.edu/journal/lawrev/57/harper.pdf (citing *United States v. Miller*, 425 U.S. 435 (1976)).
[434] James X. Dempsey, *Keynote Address: The Path to ECPA Reform and the Implications of* United States v. Jones, 47 U.S.F.L. REV. 479 (2012), *available at* https://cdt.org/files/pdfs/Keynote_%20USvJones.pdf.

VII. Conclusion

The privacy- and security-related challenges associated with IoT and wearable technologies will be considerable, but it is essential that experimentation and innovation in this space not be derailed on the basis of speculation about hypothetical worst-case scenarios. Profound benefits will be associated with these new technologies, but those benefits may not come about if preemptive, precautionary policy interventions limit new innovation opportunities.

Nevertheless, the public should not turn a blind eye to the challenges raised by these new developments, because "the Internet of things is not only a technological revolution, but also social revolution."[435] As these technologies become (sometimes literally) woven into the fabric of consumers' lives, they will spawn social disruptions that deserve careful consideration and constructive solutions.[436] This paper has offered a framework for accomplishing that goal without derailing innovative efforts that could yield countless life-enriching applications and opportunities.

To the extent that some public policy responses are needed to guide technological developments, simple legal principles are greatly preferable to technology-specific, micromanaged regulatory regimes. Ex ante (preemptive and precautionary) regulation is often highly inefficient, even to the extent of being dangerous. Prospective regulation based on speculation about future harms that may never materialize is likely to come at the expense of innovation and growth opportunities. When corrective actions are needed to address more

---

[435] Patrick Thibodeau, *The Philosophy of IoT: Will It Help or Hurt? Big Questions About the Internet of Things Are on the Agenda at a July Conference*, COMPUTERWORLD (May 26, 2014), http://www.computerworld.com/s/article/9248530/The_philosophy_of_IoT_Will_it_help_or_hurt_ (quoting Justin McKeown, head of the program for Fine Art and Computer Science at York St. John).

[436] Langley, *supra* note 170 (quoting Simon Randall of wearable camera maker Autographer) ("I think in 10 years' time it'll be pretty easy to put a wafer level camera in a lapel—if you wanted to.").

serious harms, ex post measures—especially via common-law actions and FTC enforcement activities—will generally be more sensible.

Using such a balanced, layered approach to privacy and security concerns will ensure that those important values can be protected without derailing the many beneficial forms of economic and social innovation that could flow from IoT and wearable technologies.