CELLULAR CONVERGENCE AND THE DEATH OF PRIVACY

Stephen B. Wicker

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(Based on the Declaration of Principles jointly adopted by a Committee of the American Bar Association and a Committee of Publishers and Associations.)

To Sarah

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Preface

A DILIGENT READER of the *New York Times* will have noticed that articles on electronic privacy have become an almost daily occurrence. This is due to two trends: an increasing sensitivity on the part of the public and a dramatic increase in the threat to privacy caused by modern technology. With regard to the latter, cellular technology has become the biggest contributor. Cellular has always been a surveillance technology, but cellular convergence—the recent tendency for all forms of communication to converge onto the cellular handset—has dramatically increased the ability of service providers, law enforcement, and marketers to collect data that reveals the behavior, preferences, and beliefs of cellular telephone users. This book explores this threat, and then considers possible solutions. Along the way, we will see that the immense potential for cellular has been inhibited by its twin stewards, the Federal Communications Commission (FCC) and the service providers. This is the story of a technology that may change the face of politics and economics, but the nature of that change remains up in the air. Cellular may become an empowering instrument for speech and self-actualization, or it may just continue to drift toward a refined tracking technology whose primary role is to promote consumption. We shall see.

I have been privileged to serve for the past eight years as the Cornell Principal Investigator for the National Science Foundation (NSF) TRUST Science and Technology Center, a center dedicated to cybersecurity, privacy, and the protection of the nation's critical infrastructure. At the kickoff meeting for the TRUST

center in 2005, I gave a talk on the use of sensor networks in public spaces. After my talk, I was cornered by Pam Samuelson, a distinguished member of the faculty of the University of California at Berkeley Law School. She wanted to know how I addressed the issues of disclosure and consent. Under the gentle pressure of those questions, I began to develop my appreciation for the field of privacy. This book is in no way Pam's fault, but she certainly gave me the initial impetus to write it.

Some of the work described here was funded by the NSF through the TRUST Science and Technology Center; I happily acknowledge the ongoing support of Dr. Sylvia Spengler. I am also grateful for the support of the NSF Trustworthy Computing Program, with special thanks to Dr. Lenore Zuck.

Several others have provided motivation and collaboration along the way, with particular thanks to my colleagues Lee Humphreys, Steven Jackson, Deirdre Mulligan, Shankar Sastry, Dawn Schrader, Phoebe Sengers, and Bob Thomas. I am eternally indebted to all forty-four of my past and present doctoral students, but I want to acknowledge those who followed me into the world of privacy, particularly Dipayan Ghosh, Shion Guha, Nathan Karst, Bhaskar Krishnamachari, Mikhail Lisovich, and Stephanie Santoso. I offer particular thanks to Stephanie for her contributions to the final chapter of this book.

I would like to thank those who read and commented on all or part of the manuscript. In particular, I want to thank my oldest (that is, my most long-standing) friend Jeff Pool. I don't know how an excellent actor, singer, and mediocre basketball player became an expert on cellular communications, but I remain grateful for the benefit to me. I would also like to thank my friends Susan Compton and John Saylor, and Adam and Tonya Engst for their comments on various chapters, their ideas, their ruthless gamesmanship, and their companionship during a glorious trip to Eleuthera. I continue to lean on you all.

I would like to thank my older children, Alex and Elena, for their encouragement and comments on my work. They attended my talks when they could and provided valuable foils for my ideas. They also kept me going during a difficult time in all our lives through shark dives and painful workouts. Their younger brother Julian is thanked for sleeping through the night, to the extent he did, and for happily distracting his father when he needed it most.

Thanks also to my brother Richard, who led us all through the difficult time. Losing both parents in a matter of months is frankly awful. Having a brother willing to take on the burdens of care and administration is priceless. This book would not have been finished without his efforts.

This book is a stretch, an attempt for a (moderately) old technologist to reach out into new areas, kneeling on the shoulders of others to see what he can see, and then drawing some conclusions. It would have been easy to simply keep doing the same old thing. I would not have written this book without the support and encouragement of my wife, life partner and best friend. She has read and commented on every word I have written on the subject of privacy, and I am immensely fortunate and grateful. I dedicate this book to Sarah Susan Wicker.

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I

Cellular Convergence

IN THIS OPENING chapter we explore the nature of cellular convergence—the convergence of virtually all personal electronic communication onto a single device, the cellular platform. A brief history is provided of the evolution of the handset from an extremely large and cumbersome device dedicated to (limited) voice communication to today's smartphones. The increasing importance of the latter in the world of politics is discussed, with an emphasis on the empowerment of the individual.

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The first signs of the next shift began to reveal themselves to me on a spring afternoon in the year 2000. That was when I began to notice people on the streets of Tokyo staring at their mobile phones instead of talking to them.

HOWARD RHEINGOLD, Smart Mobs[1]

1

CELLULAR CONVERGENCE

THE FIRST CELLULAR phones (c. 1980) were large, heavy, expensive, and useful only for short voice conversations. Batteries were primitive by today's standards—a typical handset during this period supported thirty minutes of conversation before the batteries were exhausted. Over time, however, the cellular phone evolved, growing smaller while acquiring better batteries and additional functionality. In 1992, the first digital cellular phones were introduced, providing digital voice communication along with a new service called *texting*. These early digital phones also supported data calls; the data rates were extremely slow by today's standards, but the phones did function as wireless modems, supporting the connection of laptops to remote computers. By the turn of the century, we began to see *smartphones*—phones (or more accurately, cellular platforms[2]) that provided rudimentary access to the Internet. As data rates and

[1] RHEINGOLD, HOWARD. SMART MOBS. New York: Basic Books, 2002.

[2] I will use the term *platform* throughout this book to acknowledge that the word *telephone*, whose etymology derives from the Greek word *φωνη*, meaning voice or sound, is no longer fully descriptive.

computational power increased, more functions made their way onto the cellular platform. Today's smartphones support texting, World Wide Web (web) browsing, retail purchases, e-mail, location services, banking, home utility control, games, and even the occasional voice call. This is what I will refer to as *cellular convergence*—the consolidation of all forms of electronic communication onto a single cellular platform.

We will see that cellular convergence is a mixed blessing. The modern smartphone is a powerful tool for the individual, enabling a wide range of expressive acts. In particular, its use as a platform for political speech by the otherwise disempowered has been celebrated as cellular telephones have facilitated protests and served as the eyes of the world in venues ranging from the villages of Libya to the streets outside the quadrennial American political conventions.

Smart phones have also created their own economy, establishing a marketplace for apps, music, books, and newspapers. Apple's app marketplace has been particularly successful; both wide-ranging and hermetically sealed, it recently celebrated its ten-billionth sale. Overall, the app economy is estimated to have generated $20 billion in revenue in 2011 in the form of downloads, advertising, and other products.[3]

Cellular technology has been disruptive and transformative. It has changed the world. It is thus important that we recognize that cellular telephony is a surveillance technology and a serious threat to individual privacy and autonomy. Cellular technology allows service providers to compile activity and location records of ever finer granularity, records that reveal users' behavior, beliefs, and preferences. Cellular telephony is also a tightly controlled technology. Its dual stewards—the Federal Communications Commission (FCC) and the service providers—have not always been friendly to its development and its use as a platform for free expression. They have also created a highly centralized architecture that inhibits innovations and allows for the censorship of speech that is perceived as undesirable by those in control of the infrastructure.

This book explores cellular surveillance and cellular control. We will see how issues that appear to be mere design choices have downstream impact on both the individual and democratic institutions. The book concludes with a series of proposals, both technical and political, for preserving the best that this disruptive technology has to offer while reducing the impact of the technical and political decisions that have dogged cellular technology since well before the first cellular call was placed.

In the remainder of this chapter, I flesh out the world of cellular, considering its origins and its current place in our society. I then highlight the importance of the cellular platform as a tool for political speech.

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[3] http://online.wsj.com/article_email/SB10001424052702303302504577327744009046230-lMyQjAxMTAyMDEwMDExNDAyWj.html. Revenue for app sales alone was $3.5 billion. See http://www.businessinsider.com/chart-of-the-day-the-app-economy-is-35-billion-2012-6.

THE EVOLUTION OF A CELLULAR WORLD

Cellular telephones are cellular because they transmit at relatively low power levels, allowing the reuse of the radio channels by phones that are sufficiently far apart. For example, I can sit in my campus office and use a cellular voice channel that is simultaneously being used in downtown Ithaca, and perhaps over at the airport as well. The same small portion of spectrum (or spreading code or time slot, depending on the specific technology) may thus be in use for three separate calls, all at the same time in the same small college town. This is important, as the amount of wireless spectrum that we can use with any given technology is limited. The more efficient we are in using spectrum, the greater the population that can be supported by the technology in a given area. There are also economies of scale; the greater the user population, the greater the incentive for innovation, the cheaper the handsets, and so forth. Though the current system is far from ideal, it is certainly better than it used to be.

There were earlier phones that were mobile, but not cellular. They transmitted at high power levels that generally prevented reuse of the channels within a given metropolitan area. We need to start with these early mobile phones to fully understand the impact of cellular telephony.

Mobile telephones became available for use in private automobiles in the mid-1940s. They moved with the car and were thus mobile, but they were certainly not portable; a handset mounted on the dashboard of the car was wired to a 20-watt, 40-pound transmitter in the trunk.[4] These mobile phones were also very expensive and very limited in number. In 1976, only 545 customers in New York City had Bell System mobile telephones, while 3,700 potential customers passed their time on a waiting list.[5] In a later chapter, we will explore the reasons for this problem, focusing on the FCC's role in creating what amounted to an artificial scarcity. For now we will simply note that these phones were large, inefficient, and very expensive.

In 1971, the FCC reallocated a number of UHF television channels for use by prospective cellular service providers, establishing the 900-MHz band that it still used for cellular today. It would be eleven years, however, before the FCC began to issue licenses to these service providers so that this spectrum could actually be used for telephony. Partly for this reason, the world's first cellular networks were built elsewhere. Nokia and Ericsson developed and deployed the world's first international

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[4] See, for example, "Telephone Service for St. Louis Vehicles, Bell Laboratories Record, July 1946, pp. 267–9 and A. C. Peterson, Jr. "Vehicle Radiotelephony Becomes a Bell System Practice," Bell Laboratories Record, April 1947, pp. 137–41.

[5] Gibson, Stephen W. Cellular Mobile Radiotelephones. Englewood Cliffs: Prentice Hall, 1987, pg. 8.