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How to Compete in the
4G Revolution



THE
NEW
WORLD OF
Wireless

Scott Snyder

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Publishing as Wharton School Publishing
Upper Saddle River, New Jersey 07458

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Printed in the United States of America

First Printing July 2009

ISBN-10 0-13-700379-X

ISBN-13 978-0-13-700379-2

Pearson Education LTD.
Pearson Education Australia PTY, Limited.
Pearson Education Singapore, Pte. Ltd.
Pearson Education North Asia, Ltd.
Pearson Education Canada, Ltd.
Pearson Educación de México, S.A. de C.V.
Pearson Education—Japan
Pearson Education Malaysia, Pte. Ltd.

Library of Congress Cataloging-in-Publication Data

Snyder, Scott A. (Scott Andrew), 1965-

The new world of wireless : how to compete in the 4G revolution / Scott A. Snyder.

p. cm.

ISBN-13: 978-0-13-700379-2 (hardback : alk. paper)

ISBN-10: 0-13-700379-X (hardback : alk. paper)

1. Wireless communication systems--Social aspects. 2. Wireless communication systems--Economic aspects. 3. Wireless communication systems--Forecasting. 4. Interpersonal communication--Technological innovations--Social aspects. 5. Interpersonal communication--Technological innovations--Economic aspects. I. Title.

TK5103.2.S657 2009

658.8'72--dc22

2009007458

Foreword

We are rapidly approaching the fifth wave of the Information Technology revolution that has changed how people work, play, and communicate. The mainframe wave of the 1950s, '60s, and '70s created the first widely available electronic version of information that had historically been kept in ledgers, filing cabinets, and binders. The minicomputer wave of the 1970s and '80s extended this analog-to-digital trend beyond the finance and research functions at the head office to include the shop floor and regional offices. Personal computers in the 1980s and '90s made more of this information available to the individual while thankfully replacing typewriters, calculators, and “foils” for all of us. Finally, the networking wave of the 1990s and 2000s connected these islands of data and processing power through local and wide area networks and, ultimately, the Internet.

The mobility wave now in play may have the most profound impact of all. While the previous waves were built on computers that communicate, mobility represents a completely new model: communication devices that compute. Power is shifting from centrally controlled information toward a future where individuals are empowered to compute, communicate, and collaborate in a way that best meets their needs. The mainframe, minicomputer, PC, and networking waves focused on making the corporation more efficient, with very little thought of making the individual more powerful. That is about to change.

In the mobility era, the traditional hierarchy is being flipped on its head. Enterprise-out no longer works. Expectations are being rewritten. For example, the under-40 segment of the world's population has grown up believing that phone numbers are for people, not places. They do not accept that the price tag on an item is the market price. They make decisions in real time with input from both known (their social networks) and unknown (Google) sources. They keep in touch with a far larger group of people than their parents did. They blur the

lines between work, play, and communications constantly, with no need to be “unplugged” at any point in their day.

Beyond the generation gap, entire regions of the developing world have simply skipped ahead to a more productive, empowered, and entertaining way of working and living. Wired phone lines and fixed broadband Internet access will never achieve the penetration rates seen in the developed world, because people have gone directly to mobile and are not coming back.

Collectively, this is the Digital Swarm at work. We got the first glimpse of mobility’s potential in the task workers of developed economies during the early 2000s. Seventy percent of workers in these countries require mobility because they do not sit at a desk. Companies such as Symbol Technologies produced rugged mobile devices for all those nurses, truck drivers, and first responders to bring information to the point of business activity. In many ways, we were in the clipboard replacement business. The mobile device became the eyes and ears of the enterprise, providing real-time information about the prescription a patient was receiving; the loading dock a pallet was delivered to; and the battle plan for police, fire, and security personnel during natural disasters.

However, this stage of mobility was still very much enterprise-out. The mobile devices were corporate assets and spent the night in their charging cradles at work. Mobility is now transforming beyond these humble beginnings, driven by more advanced devices such as the iPhone, widely available broadband cellular, and WiFi, and dramatic changes in how individuals are using mobile voice, data, pictures, and video personally and professionally.

Scott Snyder brings a visionary and thoughtful perspective to what the impact of this Digital Swarm will be and how your organization must realign its strategy to prosper in the age of mobility. He introduces insightful scenarios for how mobility will evolve and how discontinuous this fifth wave of IT will be. Set-and-forget strategies simply will not work. Winning in the Digital Swarm will require you to constantly assess changes in your customers’ expectations, competitive set, and business model. It will place a premium on set-and-reset approaches to business strategy and execution.

The good news is that the inflection points between waves of information technology have always provided opportunities for aggressive, innovative companies to emerge as the new leaders. At the same time, the old guard will either fall by the wayside, like Digital Equipment Corporation, or reinvent themselves, like IBM. In your industry, which will you be?

—**Todd Hewlin**, Managing Partner of TCG Advisors

Introduction

When I was 14, I remember meeting some friends in a small nearby town to hang out and do something unproductive like checking out girls. By the time I got there, a few of my friends had beaten me to the punch, deciding to go to the local movie theater with a few girls they had met. Because I didn't know this, I searched frantically for them, cursing them under my breath. Just as I was ready to phone my mom from the corner pay phone, they strutted up with big grins on their faces. After unloading on them with a few expletives, I calmed down, and we grabbed a slice of pizza and a soda. The girls were gone, and I asked if my friends had gotten their numbers. They said, "Uh, we forgot to ask," and I began to question the intelligence of the guys I was hanging out with. We called my mom from the pay phone in the pizza place to ask her to pick us up. She gave me an earful because she had just been into town and would now have to drive back. I was thinking how I couldn't wait to be old enough to drive.

If I fast-forward 30 years and think about being a 14-year-old today (I have one of these creatures), here is how this same story might read. I decided to meet some friends in a nearby town after we exchanged text messages. When I got there (yes, my mom still would have driven me), I did not see my friends at our regular meeting spot, so I jumped on my mobile phone's "buddy beacon" to show where they were on a Google street map. I saw that they were at the movie theater, so I started walking in that direction. Meanwhile, I checked the local movie listings online and was happy to see that two new movies were showing that I wanted to see. In addition, I noticed a new message on my Facebook site. A girl I had met a week before, Shannon, was headed into town and wanted to see me. I shot her back a text to meet me at the movies. We got there at the same time and walked into the lobby, where my friends were standing with some girls I didn't

recognize. We all went into the theater and immediately added each other to our Facebook lists and exchanged music and video libraries. I noticed on her site that one of the girls went to a private school with my sister. By the time we finished the movie and had our pizza, I was connected to no fewer than 50 new “friends” through exchanging social nets with the new girls we had met via our cell phones. Shannon had to leave, so we agreed to exchange ideas on the next place to meet via Facebook (sounded like a date!). Meanwhile, I checked my mom’s beacon and saw that she was still parked in town, and I texted her to let her know we needed a ride home. She shot back a note that said, “Good thing you caught me.” And I was still wishing I could drive sooner.

The difference in these stories is pretty dramatic. Yet because of the relatively small incremental changes each day, we fail to see how much wireless has changed our lives and is embedded in everything we do. Changing the scenario just described into professionals and organizations, and replacing the teenagers with knowledge workers in a mobile sales force, project team, or R&D group, we are starting to witness the same dramatic changes in how we work with wireless as a key enabler. President Obama demanding to keep his BlackBerry is a testament to the new model of work and life in the unwired world!

If we think ahead to the next decade, the changes driven by wireless could be even more significant as new technologies are deployed and users continue to innovate at an accelerating pace. The most dramatic changes will be in how people, devices, and other objects self-organize to carry out coordinated activities as distributed groups with intelligent devices using wireless as a collaboration and decision-making platform. We will call this organic group behavior among empowered wireless users and objects the “Digital Swarm.” As opposed to popular terms like “convergence,” “interconnectedness,” and “pervasiveness,” which focus primarily on information networks, Digital Swarm captures the added behavioral dimension that will be fundamental in shaping the unwired future. Not only will the Digital Swarm change our lives as consumers, but it will also transform how we do business. This shift could be even

more dramatic than the disruptions created by the Internet or biotech revolutions over the last decade, because it truly lives at the intersection of human behavior and technology.

To date, most organizations and their leaders have failed to take advantage of wireless technology to create value in their business. While consumers have set a blistering pace of innovation around wireless applications such as location-based services, e-wallet, mobile entertainment, wireless social networking, and health monitoring, businesses continue to deploy wireless as little more than an extended communications medium and productivity tool. This gap will become more acute as the next generation of wireless technologies are deployed, called fourth generation, or 4G. Not only will 4G increase the performance of current wireless systems, but it also will shift the paradigm to user-centric networks and applications, with the user's device becoming the remote control for all activities. 4G will be the technology enabler for the Digital Swarm, where collective action is decentralized and self-organizing, with no boundaries, no control, and no barriers to innovation by users.

While big companies and their CIOs try to reign in unapproved devices and applications like the iPhone and Gmail, the new wireless wave is building, ready to crash down on markets, companies, and employees. Rather than brace against it, organizations must swim ahead by creating the skills, capabilities, and mindset to leverage it. Those that do will be rewarded with significant innovation and value creation. Those that don't will be swept away with the tide, because they will be ill-equipped to compete in the new unwired playing field.

The New World of Wireless is written for business leaders and managers hoping to anticipate and leverage the next wireless wave to their advantage. With the exception of a handful of past wireless innovators like FedEx and the U.S. military, and upstart models such as Helio, MeshNetworks, and Fon, most organizations have failed to capture the full potential of today's wireless networks and devices, because almost all wireless innovation has been driven by the

consumer sector. Yet we are about to see a major shift in the current wireless services model, creating disruption across the entire value chain with distributed, self-organizing wireless users gaining more primary control over future services and how they deliver value. This shift will present a unique opportunity for companies with the right skills and culture to innovate and create profit opportunities around these new platforms. It will also threaten to cripple businesses that are too rigid and hierarchical to shift the power of decisions and experimentation to the edge of their business.

This book presents a new framework, WiQ (wireless IQ), for measuring your organization's wireless readiness and assessing the potential business impact of the social, technological, economic, and political forces that are shaping the future of wireless. Tremendous value will be created and destroyed as this new and very chaotic unwired future unfolds. This book will challenge your current mindsets and business models against the possible unwired future and will identify the success strategies needed to create true competitive advantages from the Digital Swarm.

Although books have been written about current wireless networks (second- and third-generation cellular) and future wireless networks (4G), they have been technology-centric. They pay very little attention to the broader strategic and organizational context for businesses using these technologies. In fact, there is consensus that the business sector has been a laggard as a whole in adopting and leveraging wireless technology when compared to the consumer sector, where innovation is rampant. Is this because organizations lack the skills and structure to take advantage of wireless or that the networks themselves do not offer enough value to justify the investment? As the wireless paradigm shifts to users being at the center of the network, companies can ill afford not to innovate as their customers, partners, and employees become empowered by the Digital Swarm.

There are also many books on innovation and breakthrough strategies. However, none of these focuses on the enormous power of

wireless as a platform for innovation. While “business without wires” is happening in incremental ways, there is not enough thinking about what an unwired business could truly enable. Aart de Geus, CEO of Synopsys, says “Increasing computing power in cell phones creates unlimited mobility and unlimited space in which interactivity can take place. This is an amazing combination, and we have not yet seen the full fruits of it.” The timing of this book is ideal, because new signals of 4G disrupting markets and companies are appearing everywhere. As this book was being written, sales of iPhones had exceeded 30 million, and Google’s Android operating system had just been released; both are early examples of 4G cognitive devices. While companies and their employees see the change happening, they continue to react instead of adapting their organizations to take advantage of it. WiQ gives them a framework to assess their organizational gaps and identify investments to profit from the 4G wave.

The New World of Wireless fills an important need by addressing wireless innovation with the business executive in mind. By doing so, it could kick off an entire wave of transformational thinking around this emerging and highly disruptive area.

This book integrates several conceptual frameworks to interpret and assess the business impact of the emerging unwired future. These are the primary frameworks used:

- **Environmental scanning/trend scouting** to identify early signals of change and potential tipping points for emerging wireless technologies and business models
- **Systems thinking**, including Causal Influence Mapping,¹ to identify both obvious and nonobvious interactions among key drivers in shaping the unwired future
- **Scenario planning** to depict alternative futures that help frame different possible social, economic, political, and technological uncertainties around wireless²

- **Innovation methods**, including Disruptive Innovation³ and Innovation Networks, to spot both eroding and winning business models
- **Strategic options generation and evaluation** to capture the upsides and effectively manage the downsides⁴ of new wireless opportunities

The new conceptual frameworks and tools developed in the book are as follows:

- The identification of key drivers and representative scenarios to inform business decision-making and strategy around next-generation wireless.
- A new organizational assessment tool, WiQ, to determine wireless readiness for a given organization and strategic environment. Over 50 business leaders were surveyed for wireless need and readiness as part of developing the WiQ assessment tool.
- A foundational model for creating new business and product innovations using wireless.
- An adaptive strategy and decision-making framework for creating sustainable competitive advantage as the unwired future unfolds.

By leveraging existing frameworks and introducing new ones, this book provides managers with a broad “toolkit” for navigating the unwired future to create a competitive advantage for your organization. The book’s structure, as shown in Figure I.1, is built around four key objectives:

- **Understanding** the changes happening in wireless that matter to your business
- **Interpreting** how these changes will affect your organization and market
- **Innovating** around new wireless opportunities to create a competitive advantage for your business
- **Transforming** your business to harness the Digital Swarm

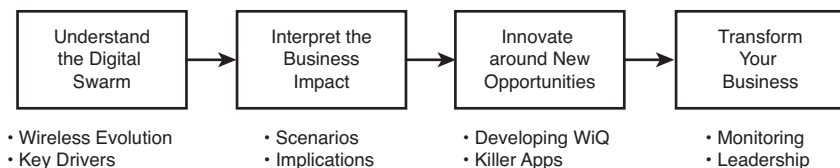


Figure I.1 This book's key objectives

Following this structure, the book starts by describing the Digital Swarm and what got us there. **Chapter 1, “The Swarm Analogy and the Wireless Revolution,”** defines the Digital Swarm and looks at the patterns of evolution in wireless that have positioned us for a new revolution. **Chapter 2, “Digital Swarm Drivers,”** provides current and emerging examples of the Digital Swarm and identifies the ten social, technological, economic, political, and environmental forces that will drive the Digital Swarm. The next several chapters establish a future view of where the Digital Swarm could go and its wide-reaching effects. **Chapter 3, “Possible Future Scenarios: Convergence, Collision, Confluence,”** presents two possible extreme scenarios for the unwired future developed from the drivers and themes identified in previous chapters. The implications of these alternative unwired futures are examined for individuals, organizations, industries in different regions of the world in **Chapter 4, “The Swarm Effect: Implications for You and Your Company.”** The next two chapters identify strategies for success and wireless innovation opportunities in the future. **Chapter 5, “Organizing for Success: Strategies and Options,”** describes success strategies needed for companies to thrive in the new unwired environment and presents the WiQ assessment tool. **Chapter 6, “Monitoring and Adapting to Early Signals,”** talks about specific innovation opportunities that may be enabled by the Digital Swarm and staked out by early adopters. The final two chapters discuss how to create an organization that can adapt and win in the Digital Swarm. **Chapter 7, “Killer Swarm Apps,”** discusses how companies can

monitor new changes and develop an adaptive strategy for sustaining a competitive advantage in the highly dynamic wireless future. **Chapter 8, “Swarm Leadership,”** summarizes the “stuff that matters” and proposes a leadership agenda to win in the Digital Swarm. **Appendix A, “Taking the WiQ Survey,”** is the WiQ Executive Survey. **Appendix B, “Wireless 101: Inside the Technology,”** is an in-depth technical overview of wireless systems in case you want to venture further into that topic.

Given the dramatic changes we have experienced so far and can expect in the future as a result of wireless technology, this book is much more the start of a journey than an endpoint. As such, the references to specific technologies and players reflect the environment at the time this book was written. Inevitably, these examples will evolve and be replaced by a new wave of examples. However, the persistent, disruptive pace of wireless and the shift to the new Digital Swarm paradigm should be a constant, no matter what scenario we end up in. Charting your own course is both the challenge and the opportunity presented by the Digital Swarm.

1

The Swarm Analogy and the Wireless Revolution

“If you’re looking for a role model in a world of complexity, you could do worse than to imitate a bee.”

—*Thomas Seely, bee expert*

Swarms have existed since the beginning of the Earth among various types of species, from insects, to fish, to birds. More recently, “swarm intelligence” has been applied to everything from airplane gate routing by Southwest Airlines to guerilla marketing with “swarmteams.”¹

The Merriam-Webster definition of a swarm is a large number of animate or inanimate things massed together and usually in motion.

If you think of wireless networks as connecting a virtual mass of users and networked objects, allowing them to converge around specific places, ideas, or activities in a semicoordinated fashion, this is, in fact, a swarm. This is a concept beyond the “convergence,” “interconnectedness,” and “pervasiveness” we have seen in information networks. Not only are swarms interconnected and pervasive, they also include a collective behavior and purpose that is not captured in these other concepts. It is this underlying characteristic that also makes it so difficult for organizations to see the early signals of this new paradigm. Figure 1.1 shows a number of wireless technologies and social networking that enable swarms among networked users, much like the coordinated activities of bees around a hive.

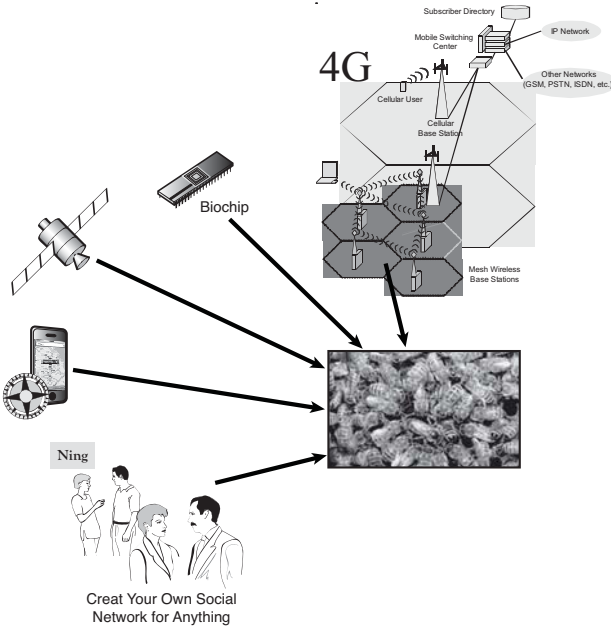


Figure 1.1 Wireless technologies and social networking enable swarms among networked users.

Wirelessly enabled swarms have occurred in recent years, such as the throngs of disgruntled citizens in the Philippines who tried to take over government buildings using text messaging to coordinate their movements.² However, the current wireless networks do not support “swarming” as a natural occurrence due to limitations in interoperability, location awareness, device intelligence, and capacity. The newest fourth generation of wireless technology, or 4G, overcomes these limitations, opening the possibility of swarming as a routine occurrence in both professional and social situations. (The three previous wireless generations will be defined later in this chapter.)

Value Proposition

Here’s why your company needs to understand and turn information about the Digital Swarm to your financial advantage:

- Wireless is now embedded in everything we do.
- This will significantly disrupt companies and markets.

- Organizations need to adapt quickly to create a competitive advantage and avoid being blindsided.

You will explore four key questions:

- What is happening in wireless that you need to know about?
- How could this play out in the marketplace?
- How will it impact your organization?
- What can you do to position for success?

First, let's try to define 4G wireless, the catalyst for the Digital Swarm, to the best extent possible, given that it is still a fuzzy, evolving collection of technologies and concepts. Several potential 4G standards are emerging, including WiMax and LTE (Long-Term Evolution). However, the commonly accepted goals are that 4G will allow typical users to get over 100 megabits per second (Mbps) to their wireless device anywhere they go. This is more than their home broadband connection and even more than a large office building does today. Users also would have smart devices that can provide the most appropriate services based on their "presence" or specific situation. This would allow 4G users to download HD movies in seconds; engage in virtual-reality business and entertainment applications; and get real-time, rich media related to their unique context and location. Sounds appealing, to say the least!

But 4G is just an enabler. The intersection of this technology platform with other social, economic, political, and technological effects will enable the Digital Swarm.

Key Insight

4G wireless will marry incredibly high speeds anywhere you go with contextual awareness to create an immersive, "user-centric" wireless experience.

A Day in the 4G Life

“Chaos in the world brings uneasiness, but it also allows the opportunity for creativity and growth.”

—*Tom Barrett, author*

Close your eyes. Imagine yourself sitting in your home or office with streams of information moving between you and the objects around you. Actions take place in your immediate environment as you orchestrate them from your mobile device. Only relevant information is sent to you as your personal “bot” negotiates and filters massive streams of data on your behalf. Your interactions with other people take the form of abstract transmissions of ideas that you exchange in real time as if they were immediate. Instead of using archaic serial communications, you can interact with several of their virtual profiles in parallel to have several conversations at once. Your device is constantly aware of your condition because your health and emotions are monitored systematically via the personal network that constantly surrounds your body. The distinction between life and work has become blurred across a continuum of time and space where decisions are made, and actions are taken to optimize both performance and personal satisfaction. You can easily immerse yourself into both real and simulated situations via high-definition digital media for both work and play. You have become a biological networked appliance who can link to the global communications grid anytime and anywhere. Like others who can afford the best technology, you have complete awareness and control whenever you need it. This is your new way of life.

Now open your eyes. This may seem like fantasy, but the notion of individuals sensing and controlling their environment without depending on the infrastructure that surrounds us today is not far off. Advances in wireless technology, distributed computing, artificial intelligence, and biotechnology are laying the foundation for a new world and society without wires. As technology drives deeper into the

human experience, a new world is beginning to emerge that we need to acknowledge and reconcile with our current assumptions. The idea of individuals self-organizing to act in a way that results in the most efficient and effective outcomes is certainly appealing. But this also raises some fundamental questions about what society would be like under these “swarmlike” conditions. There are even more practical questions about how business will be conducted and how companies will organize in this very distributed world:

- Where will the intersections of technology and social effects create tipping points for new killer applications?
- What will be the price of the information required to enable optimal decisions? Will it be at the expense of privacy or wealth?
- Who will monitor, organize, and control the individuals making the self-directed decisions? And how will the actions of these individuals be governed?
- Will companies become slaves to the actions of those who work there, or will they be able to harness the power of the “intelligent mob” to unlock significant new levels of innovation and performance?

Key Insight

The Digital Swarm will be shaped more by how people use next-generation wireless technology than the technology itself.

In the movie *Spider-Man*, Peter Parker’s Uncle Ben tells him, “With great power comes great responsibility.” Will society and individuals be able to harness the power they are given by the Digital Swarm, or will it overwhelm them? In this book, we will journey into the future unwired world and explore some of the scenarios that may unfold, and the implications for individuals, companies, and society as a whole. The images of this new world may also present some deep challenges to our current assumptions and beliefs. We must confront them if we are to succeed and thrive in the future Digital Swarm.

The Path to the 4G Wireless Era

“Cellular radio is not so much a new technology as a new idea for organizing existing technology on a larger scale.”

—George Calhoun, author

Just as many of us are getting up to speed on our 3G phones and what they can do, buzz is already starting to develop around 4G wireless. 1G, 2G, 3G, 4G, WiFi, WiMax. Is this just technobabble, or do you really need to be aware of these? My answer is an emphatic *yes*, especially given the less-than-stellar track record of both individuals and companies at anticipating the impact of technology on our lives and organizations. We do not have to look back very far to see where the best “experts” missed the signals of change or possibly even overvalued them for an emerging technology area. Many technologies take years before they have a significant impact on markets or consumers. It took almost three decades before the Internet’s potential to disrupt the retail market was realized, as shown in Figure 1.2. Yet along the road are many carcasses of companies that overinvested in what they thought was a “sure thing” during the Internet bubble, only to find out that consumers weren’t ready to change.

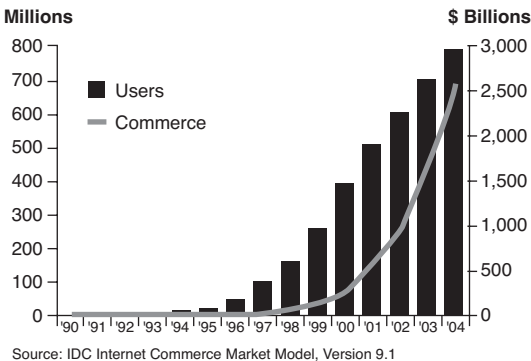


Figure 1.2 The delayed payoff of e-commerce³

Another example is biotechnology, where the promise of genomics-based medicine has been around for many years. DNA was discovered in 1953, and the first gene sequencing was done in 1972. Yet the mapping of the Human Genome was not completed until over 30 years later, in 2003. The biotech industry reached \$23 billion in 2000, rising to \$50 billion in 2005 despite \$350 billion invested.⁴ Many unexpected social, political, and technical hurdles caused biotech to take much longer than expected to deliver significant benefit to the healthcare market. Many investors, including governments, placed a lot of chips on the promise of genetically engineered drugs, only to find out that they were not ready for prime time.

Key Insight

Emerging technologies are hard to predict. Missing the important signals increases the chance that we will get blindsided or overreact.

Much like the delayed payoff of e-commerce and the market impact of biotechnology, the evolution of wireless has been hard to predict. Back in 1947, when the first cellular concept was proposed at Bell Labs, no one could have imagined the global wireless revolution that would be sparked decades later by this new technology. As with lots of other nascent technologies, large players, such as the FCC and AT&T, failed to see the potential, as evidenced by the following account:

“First, AT&T underestimated how important wireless communications would become. At the time of the break-up in 1984, AT&T relied on a report by McKinsey, a consultancy company, which claimed there would be fewer than 1 million wireless phone users by 2000. In fact, there were 740 million. Cellular technology was then spotty—calls were often lost, the signal short and the power used by devices high—so AT&T declined to enter this small market. Until, that is, 1994, when it paid \$11.5 billion for McCaw Cellular, which became AT&T Wireless and was sold last year for \$41 billion.”

—*The Economist*, January 2005

You can see how AT&T may have developed this myopic point of view. First-generation cellular, or 1G, was defined by bricklike bag phones with bulky car antennas (see Figure 1.3). They were limited to niche professional users, hardcore road warriors, and safety-conscious consumers. When driving in North America, you could travel through vast expanses where the device did not work. At the time, mobile phones were huge and expensive (\$1,500 or more), and service also was expensive and not available everywhere.

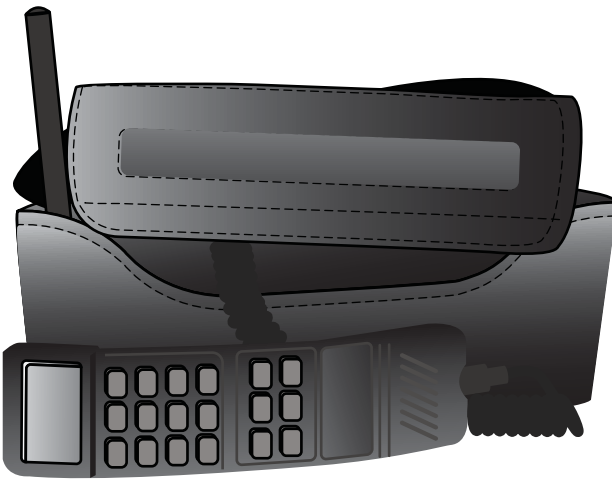


Figure 1.3 A typical 1G “brick phone”

Key Insight

Like many emerging technologies, wireless looked unattractive and uneconomical at the outset—until consumers understood the true value of mobility.

Second Generation: Wireless Takes Off

Despite the significant barriers to adoption, early analog mobile services still provided significant value to a small segment of high-end users. But it was the introduction of low-cost digital technology and a dominant global standard, Global System for Mobile Communications (GSM), which enabled wireless to become one of the fastest-growing technologies in history. Code Division Multiple Access (CDMA) offered a competing standard to GSM, but it gained very little traction outside the United States due to intellectual property (IP) ownership issues with Qualcomm and other firms. By converting communication signals into 1s and 0s, wireless systems could provide a higher-quality experience with smaller, cheaper handsets. This increased the number of users they could serve in a given coverage area, thus reducing their overall operational costs. Digital also enabled wireless services to easily carry data over the same networks as voice calls, opening a whole new set of potential applications and eventually higher-speed data services (sometimes called 2.5G). By 2003, 2G cellular had driven the total number of wireless users in the world past the total number of fixed-line telephone users (see Figure 1.4), and it never looked back.

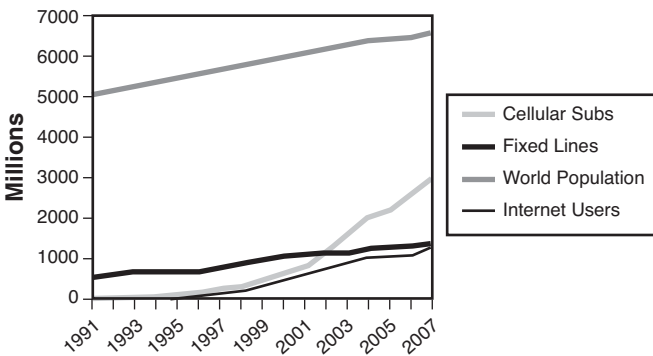


Figure 1.4 Growth in cellular phone usage⁵

Key Insight

The economics and reduced size of digital electronics, coupled with a global standard (GSM), allowed cellular to grow exponentially to billions of users.

WiFi: Making Everyone a Communications Company

As cellular was following its natural and political evolution, a new technology called WiFi was emerging from the edges in the homes of consumers and offices of small businesses. The killer aspect of WiFi was that it used the unlicensed part of the airwaves. This meant that anyone could plug in a WiFi access point and have broadband up and running within 150 feet. The ease of use and elimination of wires made WiFi an instant hit, with over 178,000 hot spots globally as of 2007.⁶ When WiFi chipsets became standard in new laptops and many popular destinations incorporated hot spots, WiFi really took off. Now WiFi is even used to carry Internet voice (or voice over IP) for free as an alternative to fixed-line or cellular phone calls. Figure 1.5 shows the incredible growth of WiFi devices.

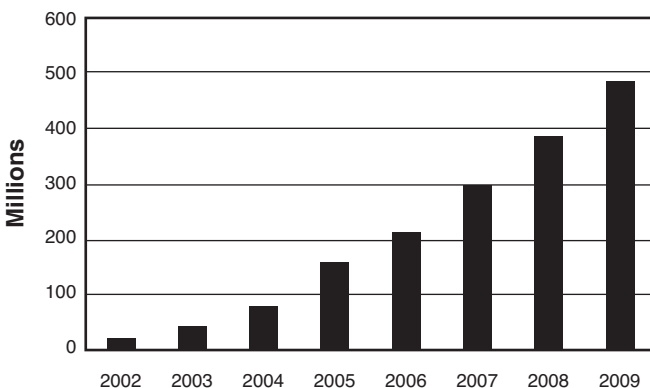


Figure 1.5 Sales of WiFi devices⁷

Key Insight

WiFi disrupted the traditional telecom cost model by using free air-waves and low-cost electronics to give users easy broadband access.

Yet, as with 1G cellular, very few analysts saw the long-term promise of WiFi in its early stages. In fact, what analysts thought was a \$200 million market before 2000 quickly became a \$2 billion plus market for WiFi-related equipment and services by 2004.⁸

Third Generation: Unfulfilled Promises

2G wireless needed only basic voice and text to ignite a revolution where “mobility” was the killer app. But 3G started with high expectations to deliver a new, unplugged broadband experience that would support a whole new breed of multimedia applications. The dominant theory at the time was that users would pay more for the new, rich set of broadband services that 3G could offer, presenting a large revenue opportunity. In fact, the Strategis Group predicted that 3G-related revenues would reach \$33 billion in 2000. The expectations were so high that leading wireless carriers in Europe paid a total of \$70 billion for 3G licenses.⁹ Unfortunately, this “irrational exuberance” led to over \$160 billion in debt and an average drop in stock price of 60% among these same companies. 3G services have been extremely slow to penetrate the market and deliver real revenues.¹⁰ (Actual revenues were about \$5 billion in 2004 using a generous definition of 3G services.¹¹) So why did 3G fail to deliver after 2G was so successful? The primary impediments to 3G’s success have been the following:

- **Outdated performance targets**—3G was designed to be competitive with broadband speeds in 1998 of about 250 kilobits per second (Kbps). These speeds recently have increased dramatically, to well over 1Mbps, but 3G did not.
- **Intellectual property ownership**—Because of the technology selected for 3G (CDMA), IP and licensing costs became a

significant issue. A few companies (Qualcomm and others) own a significant share of the supporting IP, resulting in royalties of several dollars per handset.

- **WiFi disruption**—Because of its higher speeds and disruptive economics due to free spectrum and cheap devices, WiFi's growth may have undermined the rollout of 3G and its perceived benefits.
- **Lack of compelling applications**—So where is the killer app? Other than faster web access, no other real bandwidth grabbers were being heavily used, because TV and wireless gaming were still relatively small markets.
- **Handset limitations**—Until the iPhone, the basic handset design changed only incrementally as bandwidth started to increase. Browsing the web still required a sluggish translation to have the page content fit the small screen, offsetting many of the improvements in bandwidth.

Key Insight

Wireless providers overinvested in 3G on the promise of wireless broadband revenues, but it has fallen far short of expectations.

4G Wireless: Enabling the Digital Swarm

Despite some of the setbacks, never before has the future of wireless communications been so promising, with nearly 4 billion users worldwide.¹² New technologies and standards looming on the horizon have the potential to create major disruptions not only in the wireless sector, but in communications as a whole. Whereas 3G networks were really about better technology to deliver more of the same, 4G networks are about new technology coupled with a transformation in how people use wireless, moving control to the user. I call this transformation the Digital Swarm. This book explores the underlying forces coming together to shape the Digital Swarm and how they will change the game.

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