1 Introduction: The Myth and Mess of Ubiquitous Computing

Ubiquitous computing names the third wave in computing, just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. Next comes ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives.

—Mark Weiser, "The Computer for the 21st Century"

In Palo Alto, California, on Coyote Hill Road, in sight of the foothills of the coastal range, the Xerox Corporation runs a research and development center. Xerox founded its Palo Alto Research Center, or PARC as it is known, in 1970, and it has gone on to be a significant node in the cultural geography of Silicon Valley.[1] PARC is a leading research center and the site where, famously, a small group of researchers in the 1970s invented many of the elements of the contemporary personal computing environment—personal workstations with graphical user interfaces with overlapping windows, mice, local area networking, digital typography and document production, and more. PARC also helped create new stories about how technology would fit into the world; the personal computer, the graphic user interface, the paperless office, and ubiquitous computing are arguably the most enduring ones. The stories, or organizing visions, told in the pages of publications like the *New York Times* and *Scientific American*, were aimed at both technical and nontechnical audiences. For insiders, these visions created the opportunities for new research projects and publications; for the general public, they were something more. They prefaced new realities and new promises, and in so doing they echoed previous technology visions—the electrical age, the radio age, the television age, and even the atomic age.

1. After operating since 1970 as Xerox PARC, PARC was spun off as an independent but wholly owned subsidiary, PARC, Inc., in 2002.

Like those earlier technovisions, PARC's technotales would also become myths: they would create a way to make sense of the future that appeared simultaneously magically but also manageably. That these myths emanated from the center of Silicon Valley gave them a sense of inevitability as well. After all, if smart engineers and computer scientists say this is our future, then surely it will be true. This kind of rhetorical positioning also meant that to be skeptical of such visions was to be seen as against progress, a Luddite or worse. And like all good myths, there would be heroes, seemingly impossible tasks, perils, pitfalls, and dangers, and of course, in the end, glory.

In the late 1980s and early 1990s, a team of researchers at PARC, led by computer scientist Mark Weiser, found itself in a world shaped by two different yet increasingly convergent mythical stories. The team operated in a research culture framed by the "personal computer" story about the transformation of massive mainframe industrial computation machinery into something smaller, more intimate, and with the power to change human relations with technology and each other. It was also the first days of a new era, the "information age," also arguably mythical, where binary code would replace physical labor and information would trump mechanization as a driving economic force. Inhabiting a world very much bookended by these two stories—the personal computer and the information age—Weiser and his team, following early PARC researcher Alan Kay's injunction to predict the future by inventing it, staked their own claim in the technomythscape.

In talks, publications, and hallway conversations, a story about the next future of computation and also the next stage of the future of humanity emerged. This tale coalesced, in 1991, around the notion of ubiquitous computing (ubicomp)—a vision, as articulated by Weiser, that made sense of the information age while suggesting that personal computing had not gone far enough.

Weiser argued that the first era of computing had been that of mainframes—large, centralized computers used by hundreds or thousands of people. The second era, personal computing, was characterized by "a computer on everyday desktop," a world in which computational resources were deployed on a personal level. In the third era, ubiquitous computing, he contended that computational devices would be small and powerful enough to be worn, carried, or embedded in the world around us—in doors and tables, the fabric of clothes and buildings, and the objects of everyday life.

Computing technology, in this ubicomp vision, would be everywhere, anticipatory, and far more practical—it would be useful as well as

extraordinary. In this way, it was a familiar formulation—a technological breakthrough that would, when realized properly, change social relations, social order, and daily life, creating new possibilities, both commercial and cultural. In the meantime, ubicomp was a useful organizing principle for industrial and academic research, conferences, journal articles, and papers along with prototypes, test beds, and experimentation. It has come to be broadly recognized in academic, commercial, and government settings worldwide as one of the key agendas for information technology research. And it has held sway, in a range of sites and guises, for more than twenty years. Influencing more than two generations of scholars, it has become a foundational story, a technomyth, in computer science and allied fields and as a result has shaped the kinds of technologies that have been made and also made possible.

Writing toward the end of the twentieth century, the pioneers in ubicomp research tried to anticipate the impacts and applications of their technologies decades into the future. That time, of course, is now, and many aspects of their vision have been realized, at least from a technological perspective. Weiser anticipated a world suffused with information technology, in which daily life might bring some people into contact with many, interconnected digital devices, large and small. For many people, in many parts of the world, this is indeed a fair characterization, but it only goes so far. Important considerations were unexamined or unexpected by the early researchers, from the widespread use of mobile communications technology in the developing world to the impact of location-based services on how Japanese teens interact, the emergence of new forms of political engagement online, or the need for legislation to curb our use of distracting devices while driving.

In this book, we examine the process of "divining a digital future." "Divining" has multiple meanings here. Most immediately, we consciously evoke the notion of divination—the complex and somewhat mystical process of inquiring into future events. We are struck, relatedly, by the link to the kinds of things that people do with divining rods—looking to uncover what lies hidden from immediate sight. At the same time, the notion of the divine—a search for transcendental phenomena, and a process by which some truths are found to lie beyond the realm of the mundane—is also implicated in the contemporary practice of conjuring technological futures. This is the broad landscape, but our particular attention is more locally to the domain of ubicomp in which we are both ourselves situated. Taking ubicomp to be at once a technological and an imaginative effort, we explore the vision that has driven the ubicomp

research agenda and the contemporary practices that have emerged. Drawing on cross-cultural investigations of technology adoption, we argue for developing a "ubiquitous computing of the present" that takes the messiness of everyday life as a central theme.

Our goal is to understand the mythology of ubicomp. When we talk in terms of myths, we do not mean to suggest that ubicomp is somehow false or mistaken. We instead want to direct attention toward the ideas that animate and drive ubicomp forward, in much the same way that myths provide human cultures with ways of understanding the world and celebrating their values. As Vincent Mosco (2004, 3) notes:

> Useful as it is to recognize the lie in the myth, it is important to state at the outset that myths mean more than falsehoods or cons; indeed, they matter greatly. Myths are stories that animate individuals and societies by providing paths to transcendence that lift people out of the banality of everyday life. They offer an entrance to another reality; a reality once characterized by the promise of the sublime.

The myths we want to examine, then, are the stories that motivate and celebrate the development of the ubicomp agenda. They are the ideas that give it shape and meaning. They are ideas about what technology can do for people, the places it will go, and the needs it will address. While we might not often see technology in mythical terms, it is a useful strategy to uncover the ideas that shape our technological world—the ideas about human action that spurred early researchers in cybernetics and artificial intelligence (Hayles 1999; Pickering 2010), the cold war rhetoric that drove the development of digital computing (Edwards 1996), the notions of politics and community that inflected the discourse of contemporary web technologies (Coyne 1999; Mosco 2004), or the visions of life and death at work in the artificial life community (Helmreich 1998).

Alongside the myth, there is the mess—the practical reality of ubicomp day to day. We do not use the term "mess" pejoratively; we rather like the mess (as anyone would be able to see who glanced at the space where we sit writing these words). When we talk of the mess, we want to suggest that the practice of any technology in the world is never quite as simple, straightforward, or idealized as it is imagined to be. For any of the infrastructures of daily life—the electricity system, the water system, telephony, digital networking, or the rest—the mess is never far away. Lift the cover, peer behind the panels, or look underneath the floor, and you will find a maze of cables, connectors, and infrastructural components, clips, clamps, and duct tape. Push further, and you will also encounter the regulatory authorities who authorize interventions and certify qualified individuals,

committees that resolve conflicting demands in the process of setting standards, governments that set policy, bureaucrats who implement it, marketers who shape our views of the role of the infrastructure in our lives, and more. Mess is always nearby.

"Mess" refers, too, to the way that technological realities are always contested. No single idea holds about what technologies are and what they do. Though many have tried, attempts to reduce this complexity to a single reading are at best unsatisfactory; as Andrew Pickering (2010, 33) observes, "Ontological monotheism is not turning out to be a pretty sight." So partly our concerns with mess highlight not just an interest in "how things could have been different" but rather how they already are different among the different groups, places, contexts, and circuits that characterize contemporary ubicomp.

This book, then, is about ubicomp. It is about the stories that have been told, and all the stories that haven't been. It is about the research that has been done, and the research that should be done. It is about what computer science has been, at the intersection of daily life and computational technology, and what it could be. It is then a book about the myth of ubicomp and its messy reality and, by necessity, about the tensions between those two very different vantage points. As such, there are many things that this book is not. It is not an ethnographic account of the ubicomp community, though surely such an account is necessary. It is not a recitation of current ubicomp experiments and a reporting out of results; we leave that to other forums. It is also not an easy read or a quick fix for ubicomp. We are concerned instead with offering a thorough and rigorous critique. In so doing, we hope to open up ubicomp to a larger audience and to make room for a far more diverse set of practitioners, collaborators, and engagements.

As a project, a "ubiquitous computing of the present" would necessarily reach beyond computer science as a disciplinary foundation. Information technology is certainly a major component here, and indeed we find those projects that ignore the materiality and practical consequences of information technology as unsatisfying as those unable to see beyond it. In attempting to understand what ubicomp is today, however, we need to understand it not just technically but also culturally, socially, politically, and economically. Often, this means starting off by understanding it historically—understanding where it came from and what kinds of ideas and hopes contributed to its development. This will be our starting point here.

So at the same time, this project is something of an interdisciplinary experiment, and one fraught with not a little danger. As a socioculturally

inclined computer scientist and a technologically inclined anthropologist, we have each always been oriented toward unconventional modes of analysis within our own disciplines. Working and writing together over the last few years, we have been able to join our voices with those of many others who have been working over many years, from different places and in different ways, to fashion a new disciplinary perspective on information technology and its workings in the world. Some amount of this project is thus a tentative exploration of alternate configurations of disciplinary and scholarly practice. A ubicomp of the present is both our topic and an exemplar of disciplinary hybridity that we find intriguing.

However, first things first: in this case it means ubicomp and its first stirrings in Palo Alto.