

Chapter I

Introduction to Ubiquitous Computing

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ABSTRACT

The present chapter is intended as a lightweight introduction to ubiquitous computing as a whole, in preparation for the more specific book parts and chapters that cover selected aspects. This chapter thus assumes the preface of this book to be prior knowledge. In the following, a brief history of ubiquitous computing (UC) is given first, concentrating on selected facts considered as necessary background for understanding the rest of the book. Some terms and a few important standards are subsequently mentioned that are considered necessary for understanding related literature. For traditional standards like those widespread in the computer networks world, at least superficial knowledge must be assumed since their coverage is impractical for a field with such diverse roots as UC. In the last part of this chapter, we will discuss two kinds of reference architectures, explain why they are important for the furthering of Ubiquitous Computing and for the reader's understanding, and briefly sketch a few of these architectures by way of example.

A BRIEF HISTORY OF UBIQUITOUS COMPUTING

Mark Weiser

The term ubiquitous computing was coined and introduced by the late Mark Weiser (1952-1999). He worked at the Xerox Palo Alto Research Cen-

ter (PARC, now an independent organization). PARC was more or less the birthplace of many developments that marked the PC era, such as the mouse, windows-based user interfaces, and the desktop metaphor (note that Xerox STAR preceded the Apple Lisa, which again preceded Microsoft Windows), laser printers, many concepts of computer supported cooperative work

(CSCW) and media spaces, and much more. This success is contributed (among other reasons) to the fact that PARC managed to integrate technology research and humanities research (computer science and “human factors” in particular) in a truly interdisciplinary way. This is important to bear in mind since a considerable number of publications argue that the difference between UC and Ambient Intelligence was the more technology/networks-centered focus of the former and the more interdisciplinary nature of the latter that considered human and societal factors. We do not agree with this argument, in particular due to the nature of the original UC research at PARC—and the fact that quite a number of UC research labs worldwide try to follow the PARC mindset. Indeed, Mark Weiser concentrated so much on user aspects that quite a number of his first prototypes were mere mockups: during corresponding user studies, users had to imagine the technology side of the devices investigated and focus on use cases, ideal form factors and desired features, integration into a pretend intelligent environment, and so forth.

Weiser’s Vision of UC

Mark Weiser’s ideas were first exposed to a large worldwide audience by way of his famous article *The Computer of the 21st Century*, published in *Scientific American* in 1991. A preprint version of this article is publicly available at: <http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html>.

Maybe the most frequently cited quotation from this article reads as follows: “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.” This was Mark’s vision for the final step in a development away from “standard PCs”, towards a proliferation and diversification of interconnected computer-based devices. A deeper understanding of Mark Weiser’s visions can be drawn from his position towards three dominant, maybe overhyped trends

in computer science at his time: virtual reality, artificial intelligence, and user agents. With a good sense for how to raise public attention, Mark criticized these three trends as leading in the wrong direction and positioned UC as a kind of “opposite trend”. We will follow Mark’s arguments for a short while and take a less dramatic view afterwards.

UC vs. Virtual Reality (VR)

According to Mark, VR “brings the world into the computer”, whereas UC “brings the computer into the world”. What he meant was that VR technology is generally based on elaborate models of an existing or imagined (excerpt of the) world. This model contains not only 3D (geometric) aspects but many more static and dynamic descriptions of what is modeled. For instance, digital mockups of cars have been pushed to the point of simulating crash tests based on the car /obstacle geometry, static, and dynamic material characteristics, laws of physics, and so forth. As the sophistication of models grows, more and more aspects of the world are entered into the computer, finally almost everything happens in the virtual space and even the human becomes a peripheral device for the computer, attached via data gloves and head-mounted displays. Mark Weiser criticized mainly the central and peripheral roles of computers and humans, respectively. He proposed to follow the UC vision in order to *invert* these roles: by abandoning the central role of computers and by embedding them in the environment (in physical objects, in particular), room is made for the *human in the center*. In this context, he used the term “embodied virtuality” as a synonym for UC. The cartoons in Figure 1 were made by Mark Weiser and provided by courtesy of PARC, the Palo Alto Research Center, Inc.

UC vs. Artificial Intelligence (AI)

In essence, Mark Weiser criticized the overly high expectations associated with AI in the 1980’s. In

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