

Ubiquitous computing bridges devices and services

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Intuit
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Thank you very much for inviting me to speak today. Today I'm going to talk about how ubiquitous computing, the fragmentation of information processing from general purpose devices to everyday objects, unifies devices and services to create opportunities for user experience design.

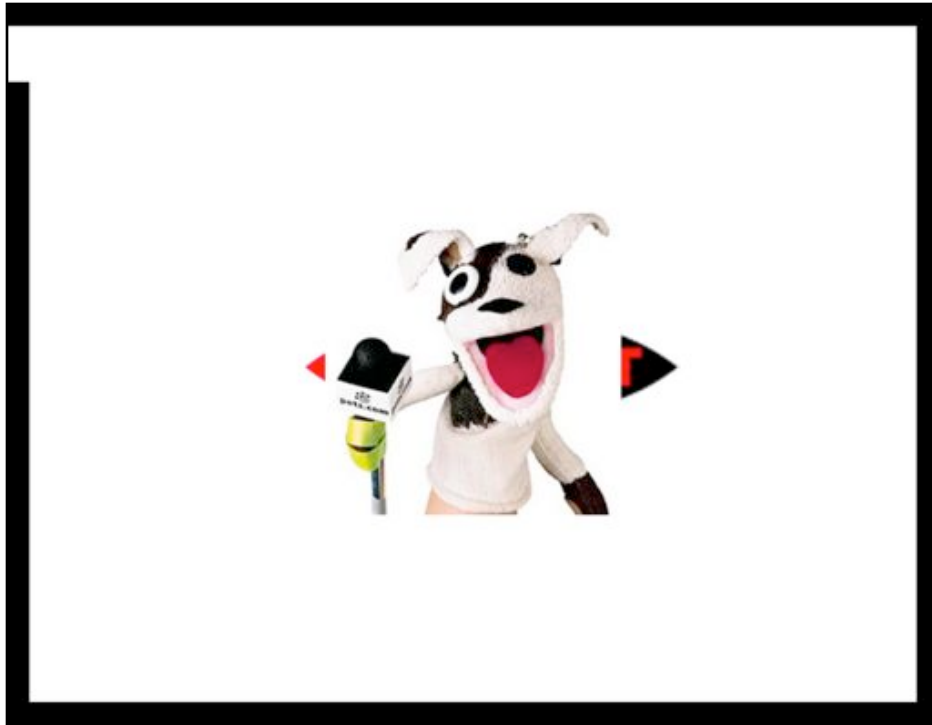


Let me start by telling you a bit about who I am.

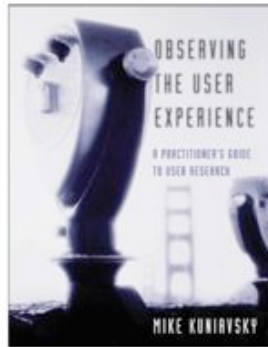
I'm a user experience researcher and designer. I have spent most of my adult life thinking about how technologies and people affect each other from social, economic, historical and technological perspectives, and how the technological side of that relationship can be made better, or at least more interesting, for the human side of it.



I started doing Web design in the Jurassic era of the Web, the early 1990s. This is the logo of a website I worked on with Andrea Gallagher, who you are lucky enough to have doing information architecture here.



During the first Web boom I did user experience design and research for a wide range of dotcoms, some famous, some infamous.



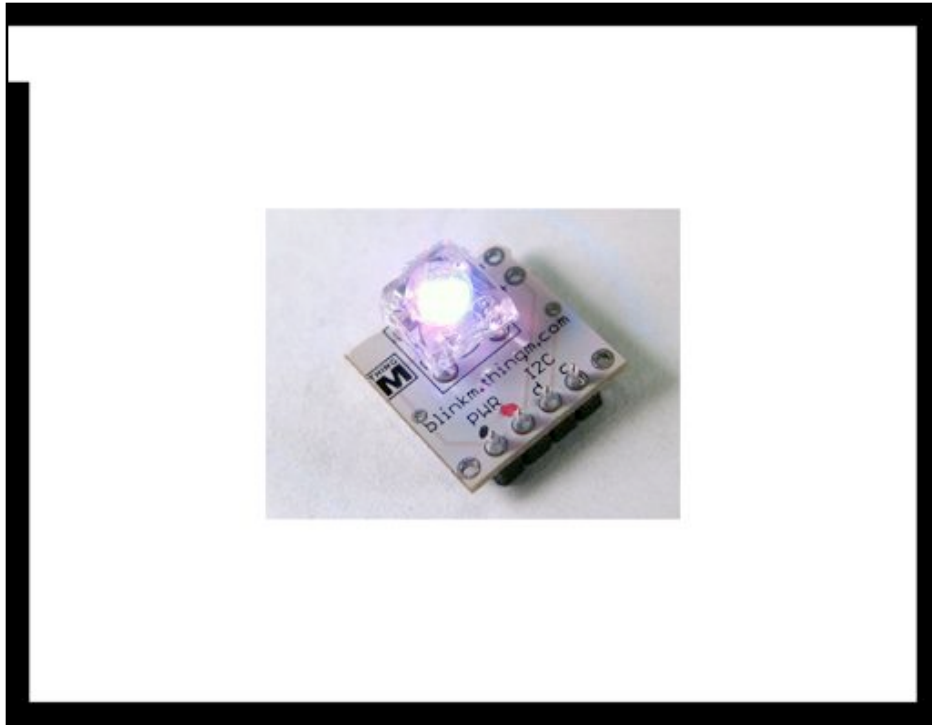
I sat out the first dotcom crash writing a book based on the work I had been doing. It's a cookbook of user research methods.



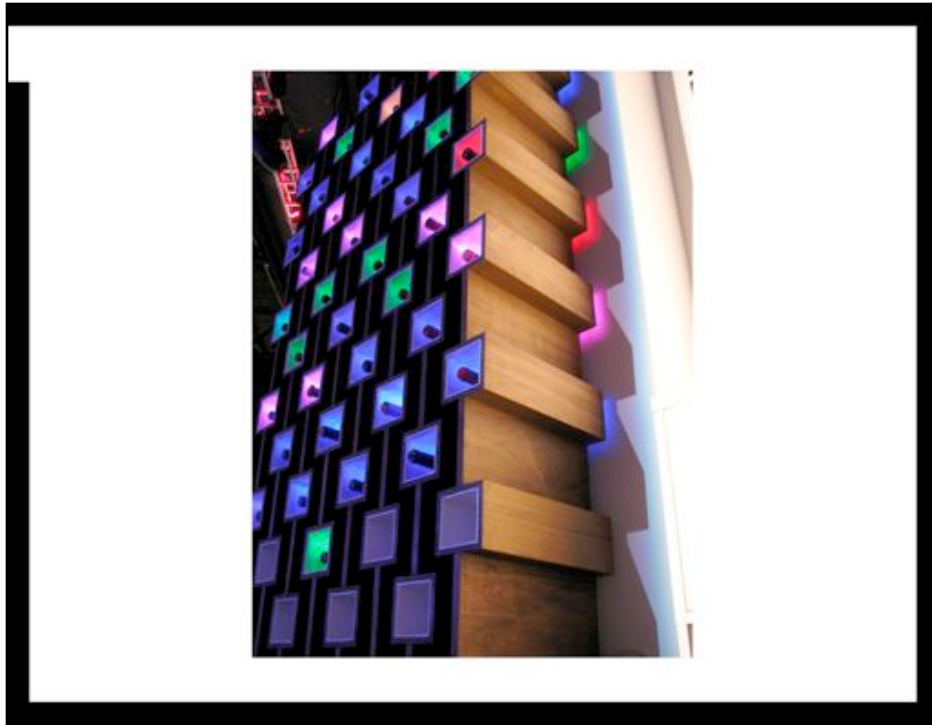
And 2001 I co-founded a design and consulting company called Adaptive Path. Things were going very well, Adaptive Path was and is doing very well, but I was interested in other ways that technology was changing people's experience of the world.



So I left the Web behind in 2005 and founded a company with Tod E. Kurt called ThingM. We're a small ubiquitous computing consumer electronics company and we design, manufacture and sell ubicomp hardware.



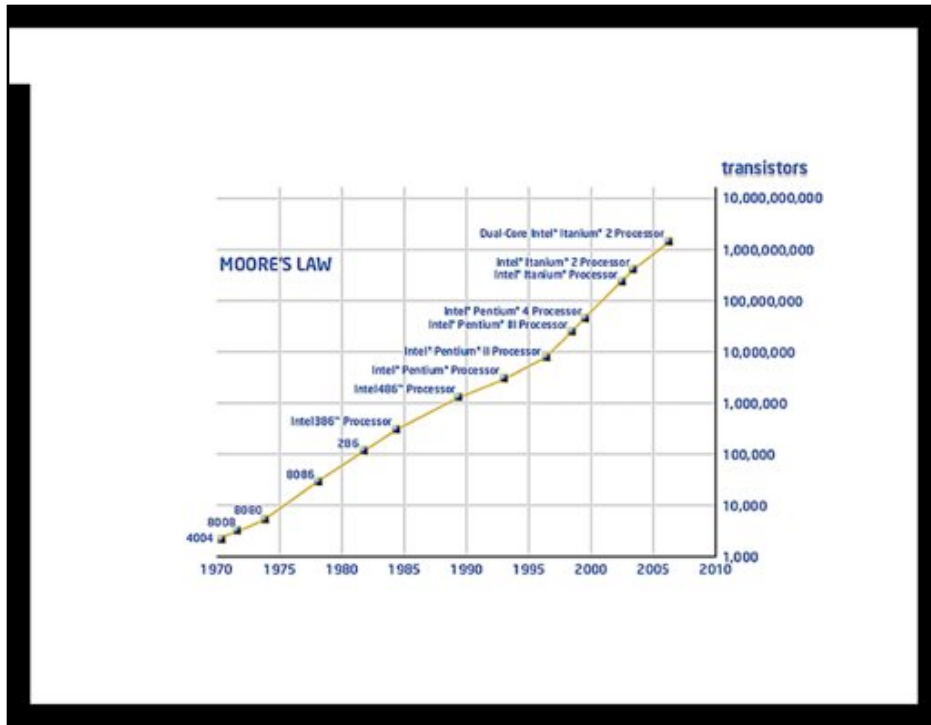
This was our first product, called a BlinkM. It's a smart LED that uses a small microprocessor to make it much easier to make a light that glows in any color or pulses in any pattern. These have been on sale for about two years.



This is a prototype of an RFID wine rack we made for WIRED Magazine's NextFest in LA a couple of years ago. It's an example of the direction we're currently going in and our first consumer product out will be coming out next spring. It will also glow in many pretty colors, but won't take up as much space.

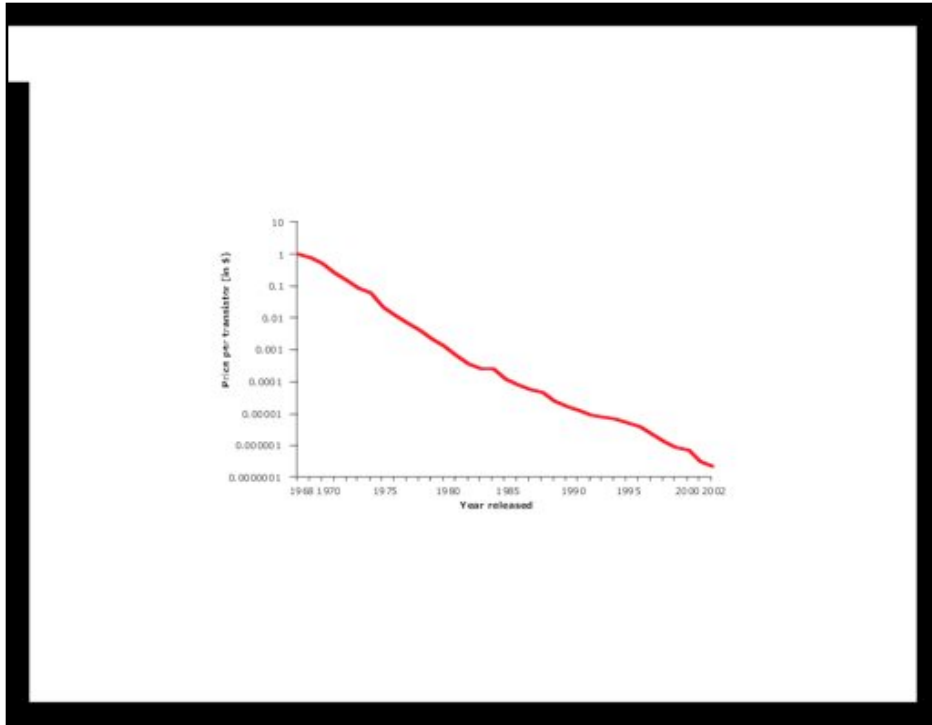


My new book, on ubiquitous computing user experience design, should also come out in the late spring or early summer on Morgan Kaufmann.



First, let me define what I mean by ubiquitous computing. The term was coined by Mark Weiser at Xerox PARC in the late 80s. I define it as the phenomenon that happens when computing gets cheap enough to expand beyond monolithic general purpose devices into increasingly more specialized devices.

Normally Moore's Law is read as a trend representing how computers are getting more powerful, but it also represents a trend that shows how technology is getting smaller and cheaper.



This is Moore's other chart, which shows the cost of transistors falling by orders of magnitude on a regular basis.

The image shows two microprocessors side-by-side. On the left is a large, square Intel 486 processor with a dark grey surface and white text. On the right is a much smaller, rectangular AVR AT Tiny processor with a dark grey surface and white text. Below each processor is its price and performance specifications.

Processor	Year	Price	Performance
Intel 486	1989	\$1500*	33MHz, 20MIPS
AVR AT Tiny	2009	\$0.50	20MHz, 20MIPS

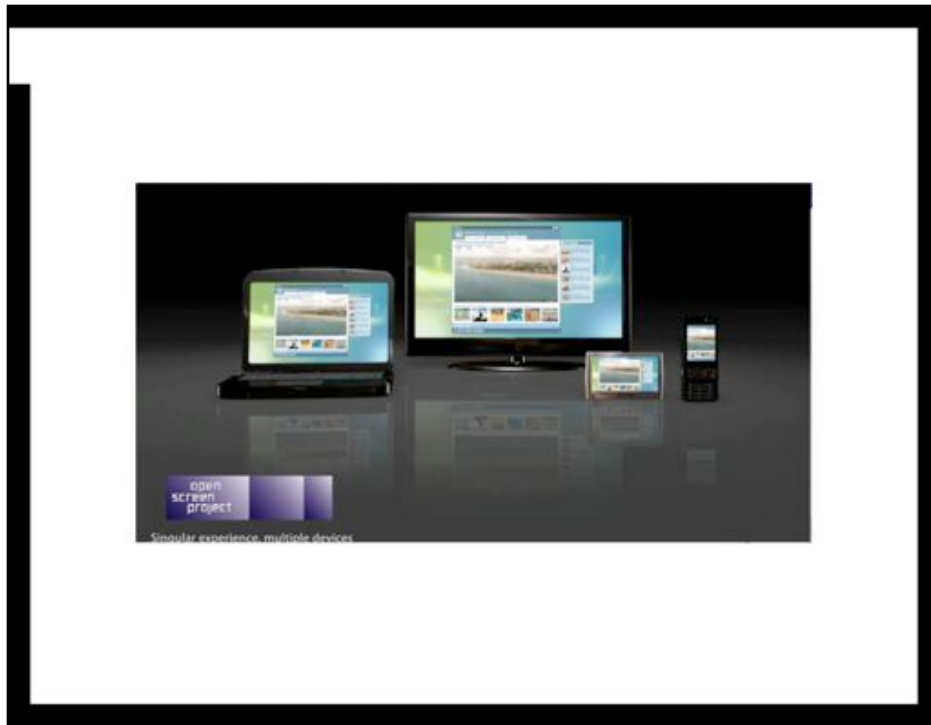
* CPI Adjusted to 2008, original price: \$900

The upshot of this trend is that information processing is now incredibly cheap. This is a comparison between the Intel 486, the processor that marked the transition from the command line to graphical user interfaces and from standalone computing to the Web and the AVR AT Tiny. The 486 was no slouch: it could execute twenty million instructions per second. Today you can get roughly that same amount of processing power for fifty cents.



This means that embedding computing into everyday objects to create competitive advantage is now cost-effective. In some industries, like toys and appliances, it's also widespread.

Tickle Me Elmo Extreme probably has as much processing power as a desktop computer did in 1990, but people don't buy it because it's a computer, people buy it because of how that computer makes it behave. Thanks to the process documented in Moore's second chart, it's possible to create such behaviors economically and relatively simply.



The advent of ubiquitous computing is also visible in the proliferation of screen form factors. First we had laptops, then we had phones. In the last year we have added netbooks, Siftables, and connected TVs. This is possible because it's now cheap enough for people to own different form factors that match the way they use information processing in their lives, rather than having to settle on a single expensive device. This is a shot from Adobe's new initiative, the Open Screen Project, which aims to create a consistent experience across all screens because they've recognized this phenomenon and are trying to head it off at the pass.

Underneath the surface, all of these devices are basically the same. You could use any one of them to plot the trajectory of an Apollo rocket, or balance a spreadsheet or play Quake. But that's no longer the point. Now that it's cheap enough to create a wide variety of computational devices, people have. Ubiquitous computing is only going to proliferate into a broader, more diverse set of devices from here.



Simultaneously, we have entered the age of the widget, which you can think of as replacing monolithic desktop or website applications with tiny chunks of highly focused user experiences. Instead of having a single application with many features made by a single company, we have personalized clusters of functionality that are assembled by end users based on their needs and desires. This is true for phones, Facebook, and increasingly true in the modular way that desktop and web-based applications are constructed.

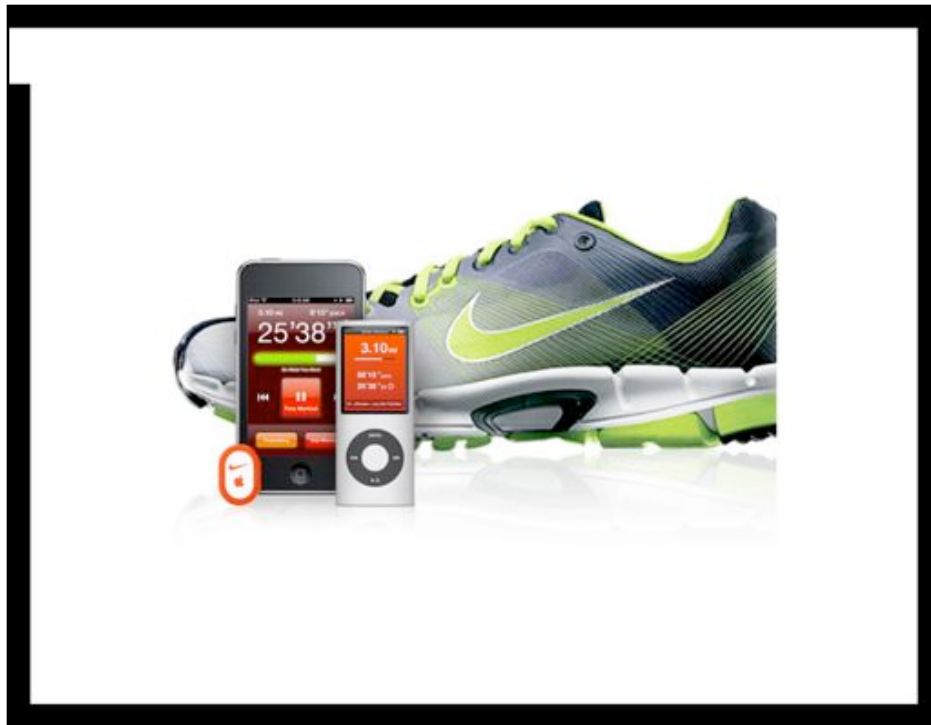


These two forces—cheap embedding of information processing and small clusters of functionality—come together to create physical fragments of information processing and networking scattered throughout the environment.

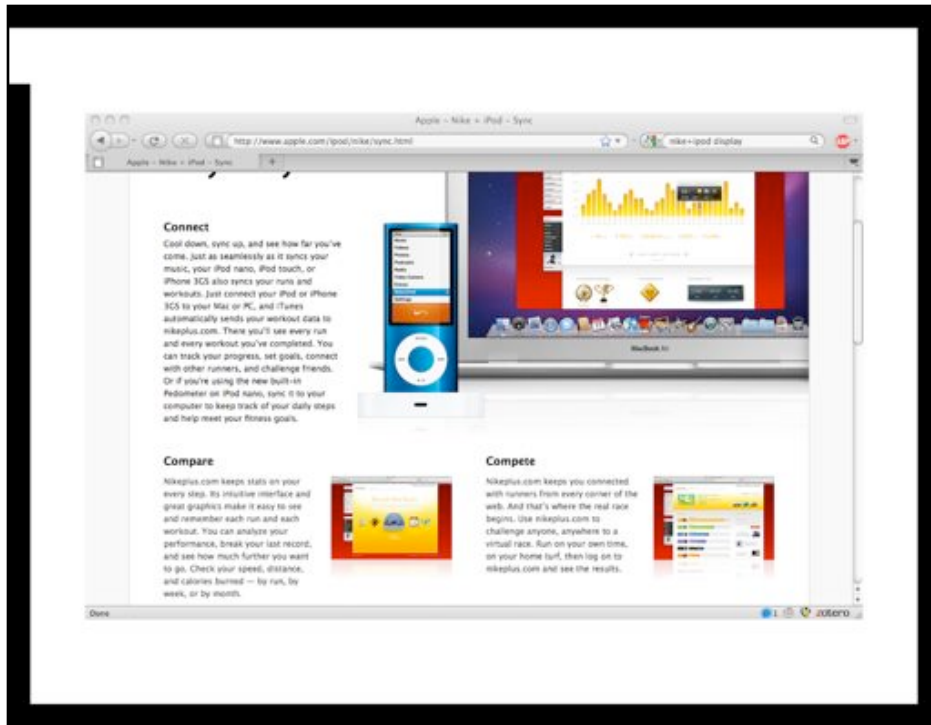
Yahoo! Has a widget service for embedding their company's products into networked televisions. Why not? In the ubiquitous computing paradigm it's no longer a question of what's a computer and what isn't—everything is a computer—but how can information processing be used to create the best user experience?



Here's Ambient Devices' baseball scoreboard device. It's been out for a couple of years. It does one thing: it shows baseball scores and stats. The red knob on the right selects which team's scores you want to see. The button above it selects the league. That's basically all it does, and that's the point. It's the equivalent of an iPhone widget, but it's a real piece of hardware that's been designed to do its one specialized task well. For the same reason that we have kitchens full of specialized appliances instead of attachments to a single electric motor, we can have clusters of specialized information processing devices instead of general purpose "computers."



The second major part of the widgetization of the world is that these ubiquitous computing devices aren't just for display, they can feed information back onto the net and utilize its full power. The Nike+iPod sensor is a simple accelerometer that registers a little blip when a runner's foot hits the ground. By itself, it's a pedometer, which is nice, but not very exciting. But take that same data and send it over a network to a web site...



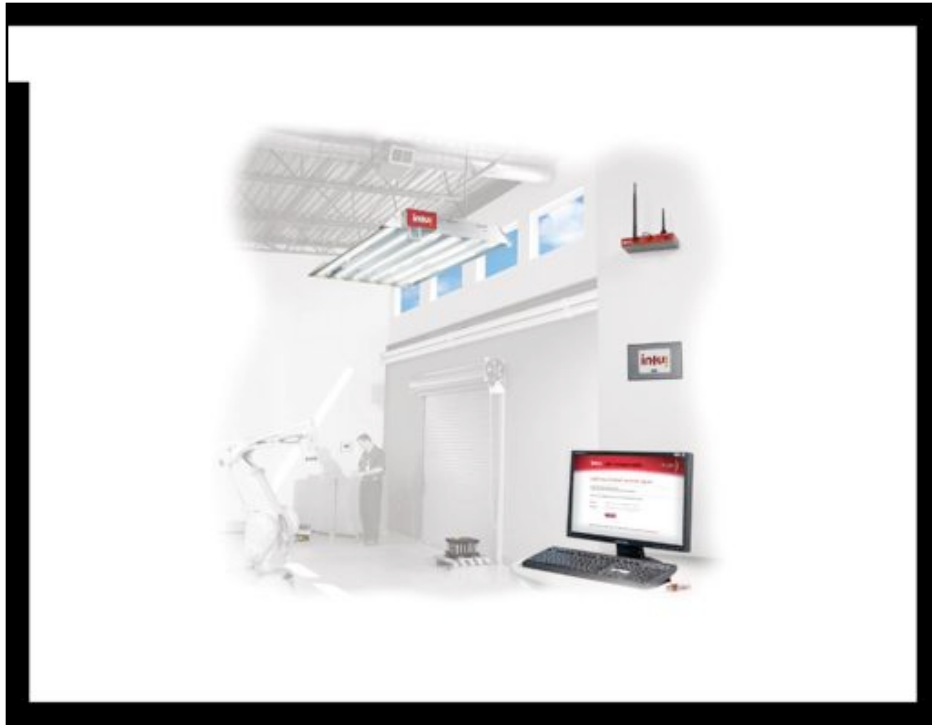
...and you get a completely different experience. You get a dashboard with metrics over time, you get analytics, you get a social network and all of the other things that you can do online once you have a key piece of information.



Another example: power companies install smart meters to make it easier for them to know energy usage and to bill their customers, but once a smart meter sends information to the power company over a network it has become a ubicomp device. The power company can turn that data around and, using spot prices on energy networks, they can calculate actual dollar values and send minute-by-minute cost information to a display widget in your home. You can use this to determine whether you want to turn on that space heater, and if you do, you can watch what happens to your energy prices in real time. This experience is not about computing, it's not about using computers, it's about using the ubiquitous computing information processing infrastructure to deliver key pieces of information at the point of decision *in the world*.



Let's take it further. Now all of the things we've learned about creating Web-based user experiences are possible to do with information collected and displayed out in the world. One startup, Opower, is using the social network between you and your neighbors to create a competition about who is saving the most energy, and there's of course no reason that a dedicated hardware device can't display this information, also. You don't need a general purpose "computer" in the mix at all.



Kanepi Innovations, a Michigan startup, goes even further. They'll automatically turn certain lights off if the pricepoint passes a certain threshold.



The technology is so cheap, you don't even need the power company to build it. Adafruit's Tweet-a-watt kit lets you do it right now. You plug stuff into it and tweets how much energy you're using. You can buy a kit to do this for \$90 today and set up a social network with your neighbors next week.

Images and graphs by Limor Fried at <http://www.ladyada.net>



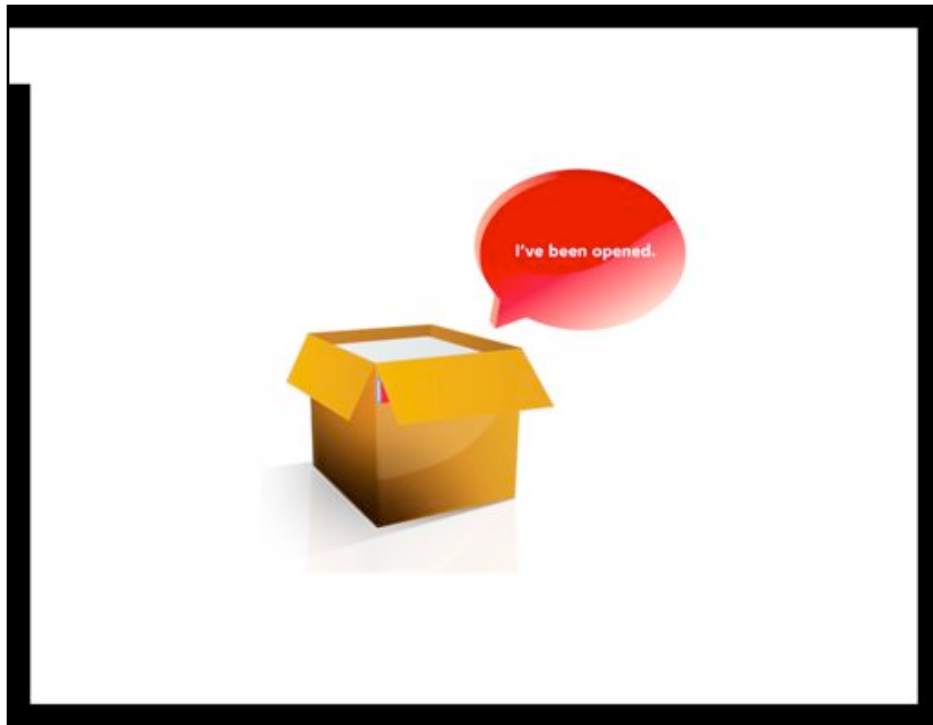
Once networked information processing is embedded in the environment, I believe we will see yet another sea change.

Image source: Yottamark



And that this shift will be even more profound. Let's start with the ATM, a pretty familiar object. This is probably one of the first ubiquitous computing devices that nearly everyone has experienced. It's particularly interesting because except for the money inside it, it's a tool, a widget, that is literally worthless without the networks it's attached to. Your cell phone is the same. The cloud goes down, it's dead.

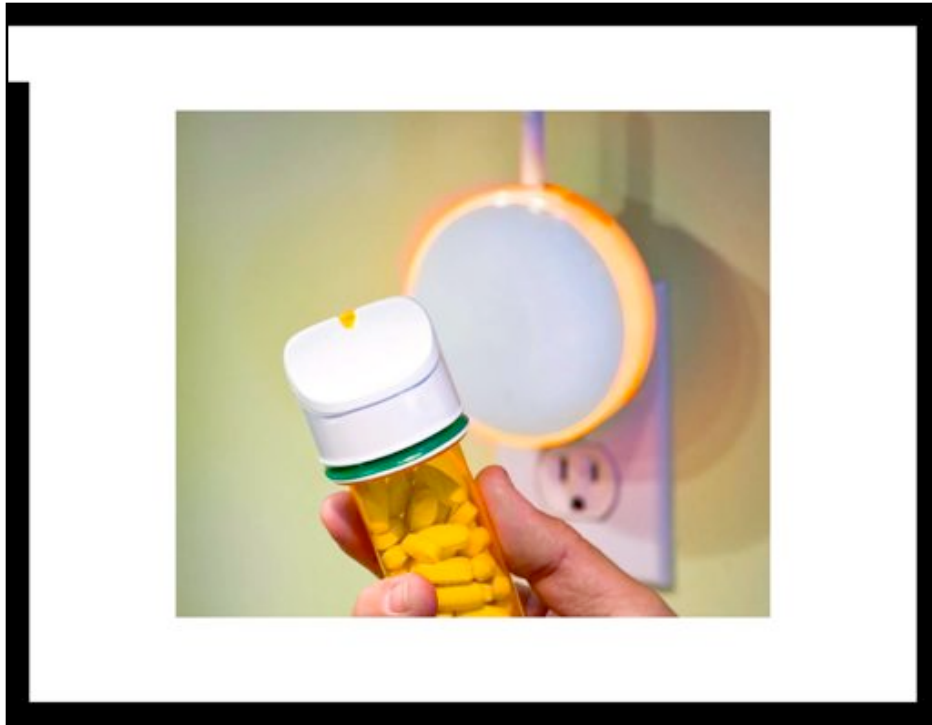
These types of devices, and there are more of them all the time, are actually services. The physical part is inconsequential relative to the service it represents. You can touch it and feel it, but the value it represents exists in the cloud. I've been calling such devices avatars of digital services.



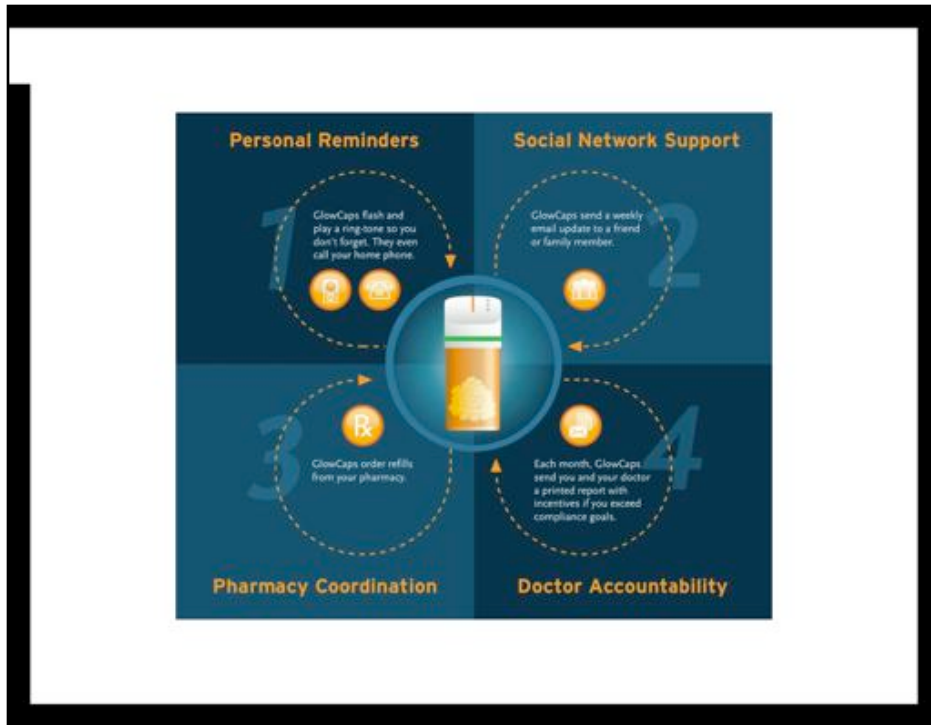
Let me show you an example. FedEx just launched SenseAware, a package tracking service. FedEx envelopes already communicate information about themselves, but they have to be queried by another device...



SenseAware puts that capability right into the packaging. Each of these pucks is essentially a specialized mobile phone that has a range of sensors on it. It tracks location, temperature, light, etc. Coupling those simple sensors with a network creates a wholly new service where you can watch, in real time, as a package moves around the world, knowing exactly where it is and what conditions its in. The service is as much about the analytics of the telemetry as it is about the physical change in location, and the box is the avatar of that service. The service couldn't exist without it, it couldn't exist without the service.



Here's another example. Vitality, another startup, is marketing the GlowCap, which is a service for increasing compliance with doctor's orders for taking prescriptions. The key piece of the system are pill bottle cap that broadcast when you've opened and closed them to a wall wart that's a modified cell phone. This relays the information to a server in the cloud.



Getting people to comply with drug regimens is probably as complex as getting them to save money, so the pill bottle is just the tip of the service design iceberg for GlowCaps. Once that data point has been entered, it puts a large system in motion that involves other patients, family, doctors, the pharmacy.



That service, in turn manifests itself in a wide array of avatars. Patients can get email, or paper letters tracking their progress. Doctors get their own reports about patient compliance, and pharmacies get their own reports. Each is tuned to the needs of its user population, but they are all enabled by this single simple interaction. And from the pill taker's perspective, there may not be a "computer" involved in the process at all.

Ubiquitous computing enables the easy and inexpensive collection and display of information throughout the environment, and once the data is in the cloud, the service can then rebroadcast it in a variety of ways.



This new kind of service relationship fundamentally challenges our ideas of how products and services work. It raises questions about the need for ownership of certain objects, about the distinctions we make between service providers, manufacturers, and brands and about the process and fundamental role of user experience design.

Photo CC by psd, found on Flickr

<http://www.flickr.com/photos/psd/2059150331/>



I believe that ubicomp offers fantastic opportunities for creating user experiences and brand experiences that transcend a single delivery platform. Experiences that we can project across a wide range of devices and still retain their singular identity.

We already see it in fields as diverse as logistics, medicine, storytelling and personal transportation.

Of course this is just the beginning. Ubiquitous computing today is where we were with the Web in 1995: the technological shift has already happened and the economics are already in place. The early products are out there, looking for the right niche that will lead to explosive growth.

This environment will soon be catalyzed into a major technological, economic and social change. The question remains, however, what's going to catalyze it? I believe that the answer will not be found in fundamentally novel technology (maybe except for batteries), but in thoughtful, excellent user experience design. We're doing our best to figure out what that is at ThingM, and I urge you to think about it, too.



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Thank you.