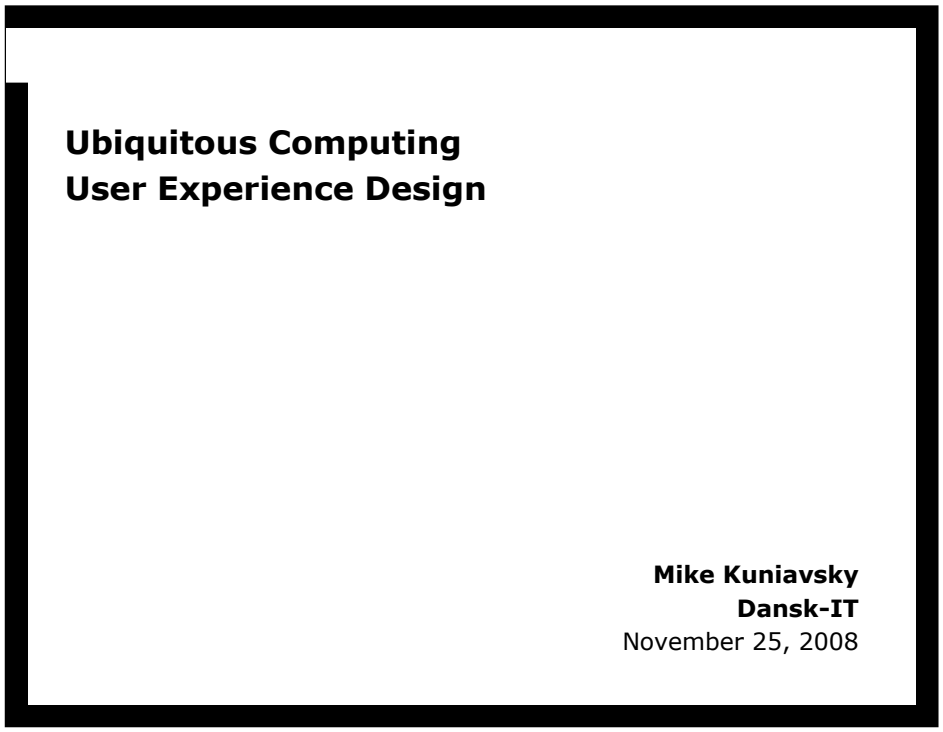


Good morning. Thank you Klaus for the invitation. It's a pleasure to be here and an honor to have been invited.

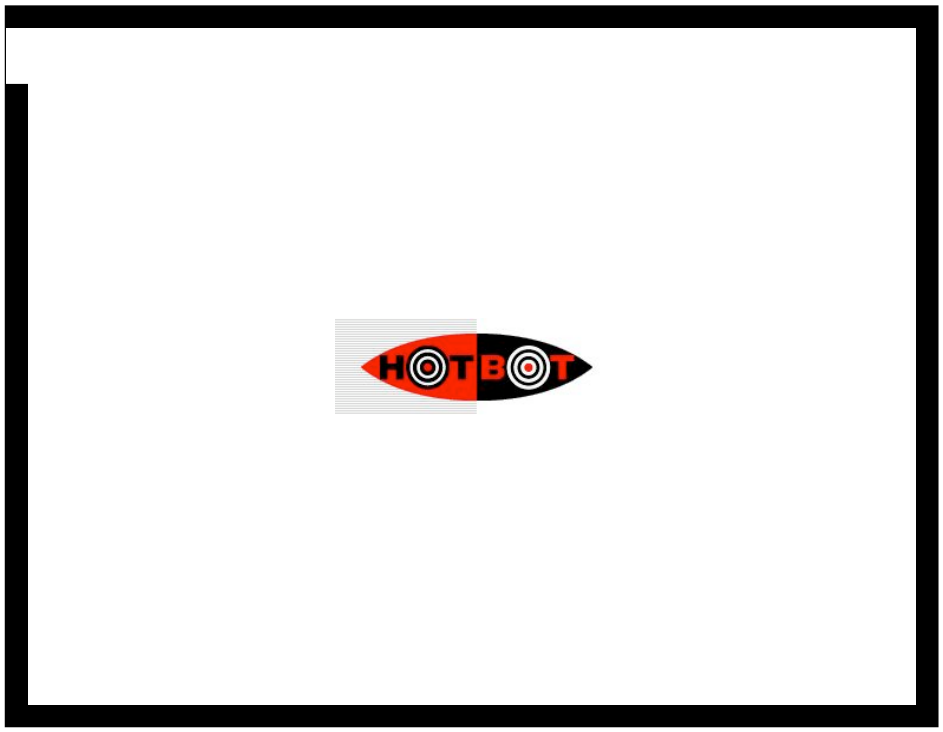
I want to talk to you today about what I believe is the most profound shift in terms of the design of information technology since the Web.

But first, let me give you some background about who I am.

I'm a user experience researcher and designer. I spend much of my time 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.

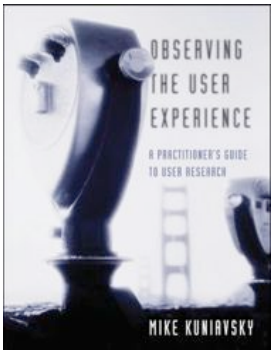
Junkyard photo CC by Sigma, Flickr.

I spent a little more than 10 years doing design and research for the web. I was the designer of one of the first ecommerce websites in 1994, HotHotHot. Despite the name, we sold hot sauce.



In 1996 I was the interaction designer of one of the first big search engines, HotBot.

In the late 90s I worked with many dotcoms, some famous, some infamous.



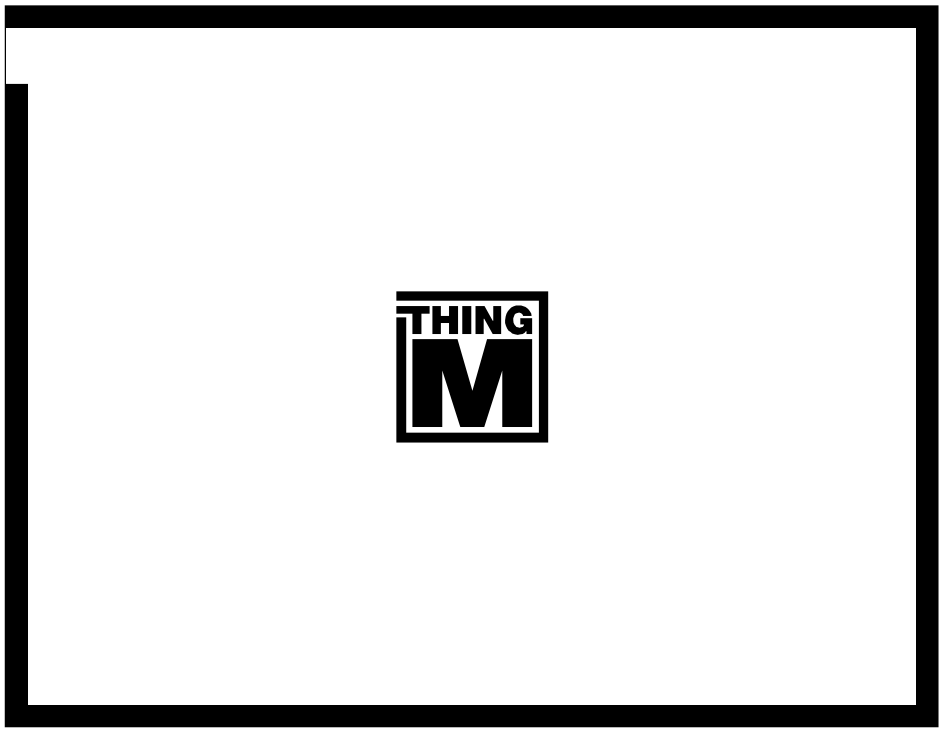
I sat out the first dotcom crash writing a book based on the work I had been doing. It's a cookbook of user research methods. Buy one for everyone on your team! ;-)

In 2001 I co-founded a design and consulting company called Adaptive Path. Things went very well, Adaptive Path is doing very well…

but ten years in cyberspace was a long time and in 2004 I decided to pause my consulting work to think full time about how to apply what I had learned about people and technology to all the other computers that were increasingly embedded in our lives.

Things like mobile phones, iPods, TiVos, smart refrigerators, smart shoes and talking greeting cards.

Photo CC by Cocoarmani, Flickr

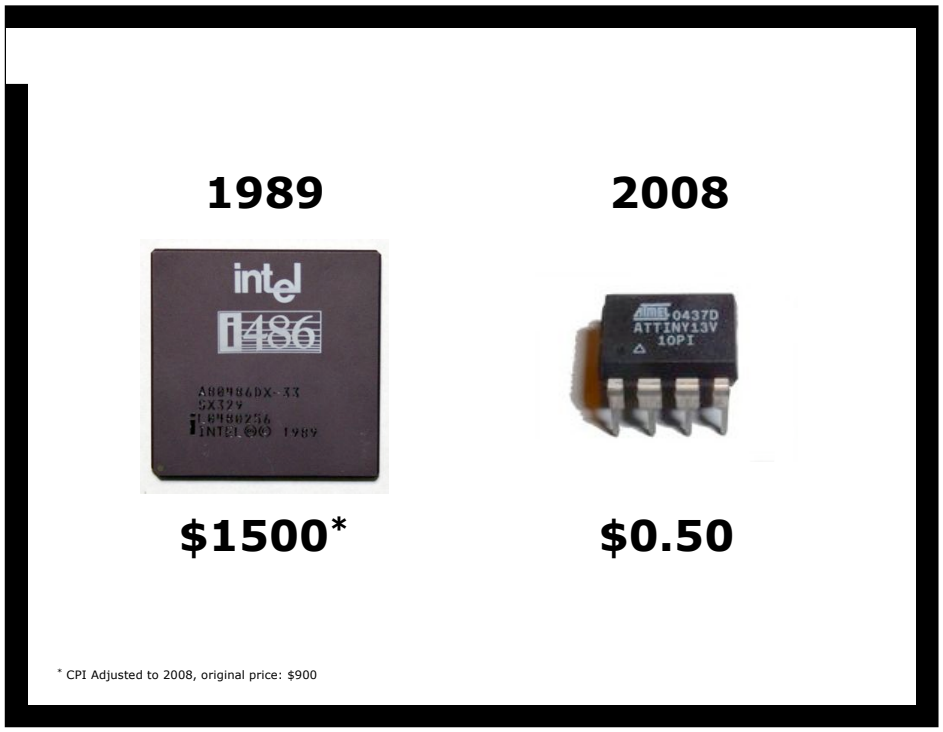


Two years I founded a company with Tod Kurt called ThingM to pursue these ideas commercially. We're a ubiquitous computing consumer electronics company, which sounds fancy, but it’s mostly just the two of us. We design, manufacture and sell ubicomp hardware.

As a designer of technology, I like to use the history of other technologies to drive some of my thinking and I would like to start today by telling you a story about alumimum.

In 1885 it was the most expensive metal on earth. More expensive than gold or platinum. So expensive that a 3 kilogram block of it, the world's largest, was put on top of the world's tallest structure, the Washington Monument. Less than a year later, in 1886, two chemists figured out that you could use electricity to extract aluminum from bauxite. That's when it was discovered that it was actually the most common metal on earth.

And we know what happened then.



Something similar has happened with information processing. At the beginning of the Internet era we had the Intel 486 as the state of the art and it cost $1500 in today's dollars.

It represents an interesting inflection point. It's a pretty powerful chip. It's the chip that ran Windows 3.1, the first successful version of Windows, and it was in the computer that were most likely to be found on people's desks when the first Web browsers appeared four years later. In many ways, it marks the beginning of the modern personal computer era, a turning point away from isolated DOS machines to connected Windows machines. As it was being released, the late Mark Weiser, then the chief technologist at Xerox PARC, was coining the term "ubiquitous computing" to describe a world where computers are woven "into the fabric of everyday life until they are indistinguishable from it." Unfortunately, this chip was still prohibitively expensive then.

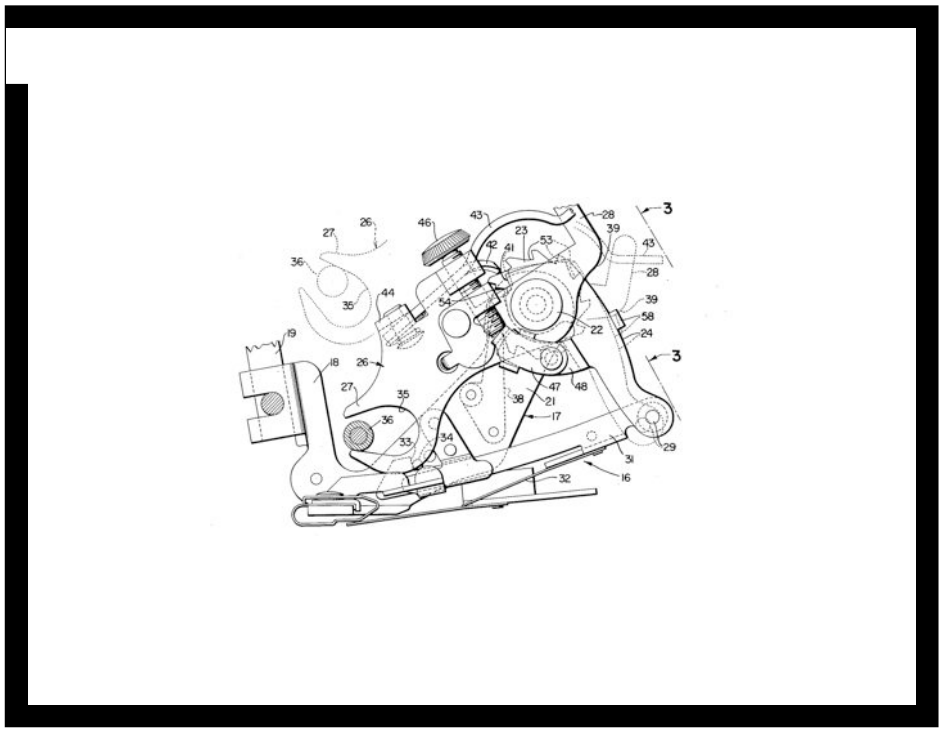
Today, you can buy that same amount of processing power for 50 cents.

When computation is this cheap, it stops being the focus of design--it's no longer the precious jewel on the monumental structure. It's just one of the blocks that goes into the construction of an object.

When computation, information processing, becomes a building block that disappears into the fabric of everyday life, it no longer becomes the focus of the thing that it's part of, it's a material with which that thing is built.

And that represents a profound shift in the design of information technology user experiences. Now that including a CPU has become a line item in the calculation about what to make it out of, the question is no longer what software do we run on this computer, but how do we design with this new material? What are its properties? What are its constraints?

Source: Flickr, Kate_A



I believe that one of the key properties is behavior. Let me explain how.

Traditional things mostly exhibit easily identifiable relationships between causes and effects (for example, something is pushed, it falls down). It's possible to disassemble the most complicated everyday mechanical object, say this thing, and with some work determine how it functions and what it does.

However, that doesn’t work for objects made with information processing. Objects that use information processing do not act as expected based purely on their physical properties.

We know this device is a phone, but it could be a calculator, a remote control or any number of other devices that have a keypad, a screen and electronics. The numbers on the chips could help identify some of its functionality, but no amount of close examination would tell you that you can send a text message with it.

The relationship between causes and effects in an object made with information processing is much more difficult to identify than with a purely mechanical one. Key aspects of its functionality are in software, which is very difficult to observe and can change what the device does without warning. Thus, these devices exhibit unpredictable behavior that is closer to that of animals or people than to traditional machines.

That behavior is the key property that makes information processing so valuable. Let me give you an example. This is the Cuddle Chimp. By itself, it's kind of an ugly chimp doll. But it acts like a newborn baby, and that behavior puts it in a different class from all of the other chimp toys, which means that the manufacturer can charge more for it, which means that behavior creates competitive advantage, which means that by the natural forces of the market we are only going to see more devices with information processing-produced behaviors. The toy industry, one of the most competitive of all, has been deep in the ubicomp business since Tickle Me Elmo came out in 1996.

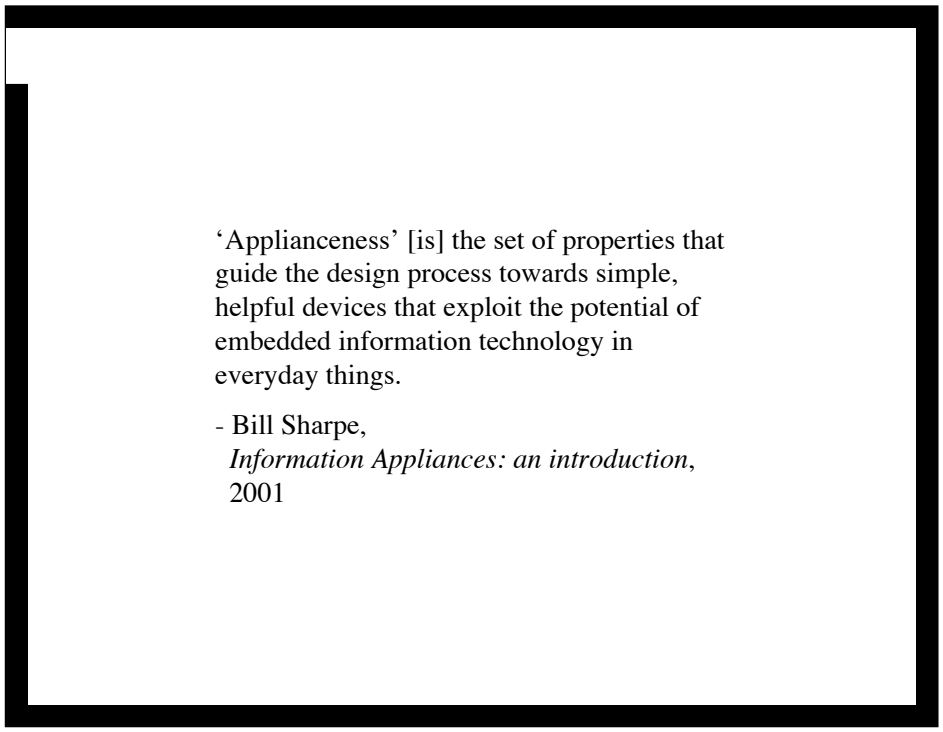
This is the Adidas 1 shoe, which has a embedded microprocessor that analyzes the running surface about 20 times a second and adjusts the stiffness of the heel in between strides in response.

It predated the Nike + iPod by two years and I think it's the more profound product because it represents the distilled knowledge of kinesiologists, coaches and runners to adjust the behavior of your shoe as you're running. It deeply embeds computation into its function, rather than keeping it as an attachment.

This is a Blendtech programmable blender. With it you can program a specific sequence of blender power, speed and duration and associate that sequence with a button on the blender.

In other words, it allows you to embed experience and knowledge about food processing into the tool, which can then produce that as a behavior, rather than requiring the operator to have that knowledge and develop the experience.

Smoothie chains in the US use these extensively. Some master food scientist has figured out a sequence that represents a “good enough in most situations” way to prepare their product. This way, their staff don’t have to be trained in the fine points of blending. It may seem like a small thing, but consistent blending is the cornerstone of their product and this embedding of knowledge into the tool wouldn’t have been possible without ubiquitous computing. The behavior is the value.



These objects exhibit what I believe is a second key property of information processing as a material and a key technique in the design of ubiquitous computing devices. It's what Bill Sharpe, a British interaction designer, calls "applianceness".

The core of the idea for me is that focus is more important than flexibility. When computation is cheap, we no longer have to make general purpose computers. Instead, we can make specific appliances that use information processing to do one thing really well. We have moved past the era where you could talk about Human-Computer Interaction as if there was one human and one computer. Now, it's one human to a multitude of appliances.

Here's one manifestation of this philosophy in software. In Windows Mobile, Microsoft tried to recreate a general-purpose compter in about 1/10 the screen real estate and to port general purpose tools to it. The iPhone takes the appliance approach, where every program on it is, essentially, a small appliance. It does one thing and tries to do it well. Apple's iPhone Appstore just hit 1000 such mini-appliances.

In a sense, you can see all of these new computational appliances as material explorations because information processing as a material is still unfamiliar, like nylon was in 1940, but now that the the economic threshhold has been crossed to make it a commodity and to make its use a competitive advantage, the design challenge is to use this material well. To make things better, easier, more profitable, or more fun.

We're still at the very beginning of this exploratory process, but I think there are several other aspects of ubiquitous computing that help clarify what the future that we're designing towards looks like.

Machine identification is another key property of this ubicomp/Internet of Things puzzle.

Tangentially, I think those two terms refer to the same social-technological phenomenon. They're just coming at it from different directions.

Manufactured things have long had identifying marks. Silversmiths' and goldsmiths' hallmarks, which were instituted in 1363 by King Edward III in England, are the first structured metadata to be embedded into the object they're describing. This is an 18th century knife blade. Hallmarks are pretty, but reading them is a pretty esoteric pursuit.

Image courtesy of Leopard Antiques, leopardantiques.com

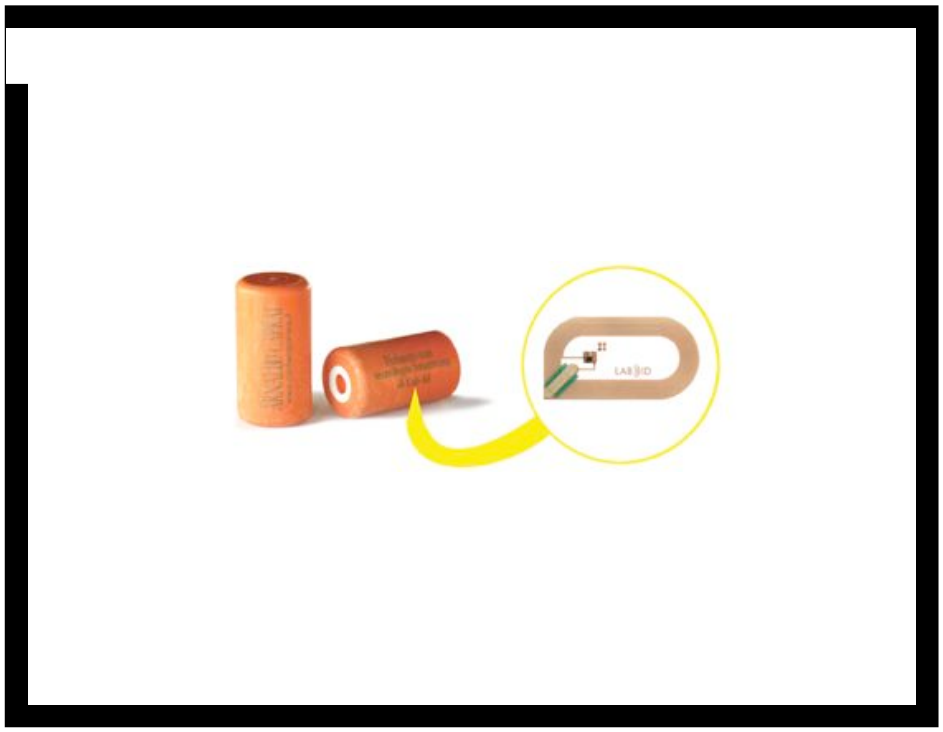
Barcodes, their modern cousins, are a little better from the user perspective. Their one advantage is that they are machine-readable. With this they create a link between the object and information about the object that's somehow automatically accessible. You don't have to know the secret code, just where the database is and have a reader.

Every object that has one exists simultaneously in the physical world and in the world of data.

Photo CC from http://www.flickr.com/photos/dumbledad/298650884/

I call this data the object's information shadow. Until recently, accessing the information shadow was difficult. The world of objects and the world of information shadows were separated by the difficulty of getting at the information. When you're in a store, you don't know what the barcode means, the store does, because only the store had the database and the hardware. And even they only know a small part of what's going on because a barcode only identifies the class of objects, not the individual object and only has the data that they put into it.

And although there's a lot of utility to being able to photograph a barcode of a book with your phone and see how much it is on Amazon, that's only the beginning of the story.



Technologies such 2D barcodes or RFIDs mean that every item can have a unique identifier. When that is combined with ubiquitous computing and wireless networking it creates the ability to instantaneously see information shadows in a way never before possible.

Image source: SmartCorq

Now you can see the information shadow of the SPECIFIC object you're looking at.

Each object has been unified with its information shadow and you can query it. You can now know about where it was made, if it is a real Gucci, what it is made of, what your friends think of it, how much it sells for on Ebay, how to cook it, how to fix it, how to recycle it, whether it will go with your mother's drapes, whatever. Any information that's available about an object can now be available immediately and associated with that object.

Image source: Yottamark

This ability to cross between the world of information shadows and physical objects mean that we're witnessing the beginning of mashups between the physical world and the data world and that will accellerate very rapidly as digital identification becomes more commonplace. We already have the network infrastructure in the form of the mobile phone network. Identification, addressing, will allow us to use that network to activate the objects around us.

This is a product called TrailRunner that uses map data from a variety of Ineternet map sources to help runners put together new and interesting runs. Then it creates a map of the run that you can download to an iPod. And here's where it gets interesting, because it then downloads the data from your Nike+iPod to keep track of how you ran the route and it creates a kind of social network with other users because you can use it to rate runs and segments of runs. All of this enabled by the combination of a simple accellerometer, a display and a network connection. The pieces are all quite simple and familiar, but the richness of the user experience is something that's brand new. And designing for it requires cutting across a number of disciplines.

Image source: TrailRunner

This is one of my favorite new ubicomp products from the toy world. It's a product from a Hong Kong company called TechnoSource that Disney is using in conjunction with their new Fairies initiative.

Let me zoom in and show you what I think is interesting. This is bridging the physical world of kids with their social network in a transparent and familiar way.

And this isn't just it. They have a whole line of products that work offline and online. You buy a piece of jewelry, it has an RFID tag in it. When you register it with your USB-connected jewelry box your fairy gets a dress and you get a present you can give to one of your friends' fairies. You play a handheld video game, your fairy gets fairy points.

It's kind of an amazing system, especially since they're so inexpensive. Clearly, the information technology is a very small part of the cost. Most of the margin is in behavior.

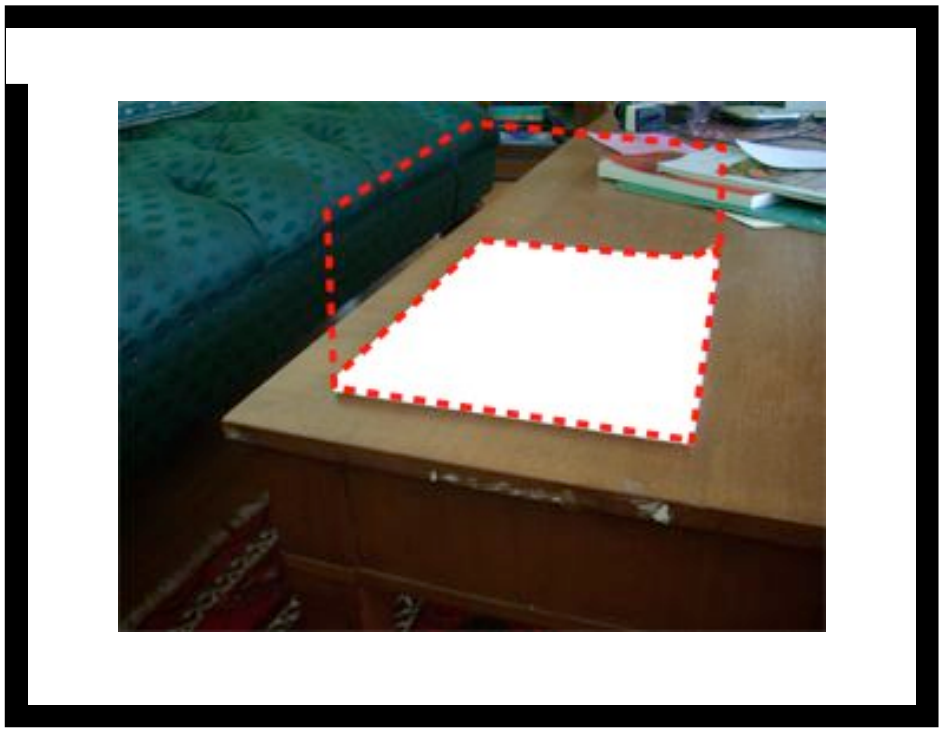
These two examples highlight the importance of the design of services, because as the information shadows of item-level identified and smart objects become embedded in the Web, their nature changes from being standalone tools to being the representatives, or avatars of services. A mobile phone, for example, is nearly useless without the service it connects to, but in some cases, the actual object may dematerialize completely. Let me give you an example.

Take a journal. What's a journal? It's an agreement between a publisher and subscriber that one will provide information of a certain type to the other. This service traditionally manifests as a softcovered book that's delivered on a regular basis.

The New England Journal of Medicine mails our doctor housemate medical information every week. Next week this one will be replaced with a similar one

When I look at this journal on our coffee table, I see a dotted line in the shape of a soft-covered book.

The outline is regularly filled in with something that addresses a set of concepts that are defined by the agreement between publisher and the subscriber.



Furthermore, the space inside the dotted line represents what can be thought of as a slice through a single object, some of which has been created, and some of which hasn't.

When I think about purchasing a subscription, I think about buying some paper that represents a chunk of the contents of that larger object

Photo CC by heipei, found on Flickr.

and as long as I, the subscriber, am interested, I kept buying new chunks.

What I, the subscriber, own is an ageement for the delivery of a service. The paper magazine is just one of many ways that the aggrement can be satisfied and the service provided.

City Carshare, the first car sharing company in the US, brings this same idea to the realm of cars and it wouldn't exist without ubiquitous computing and digital item-level identification technologies.

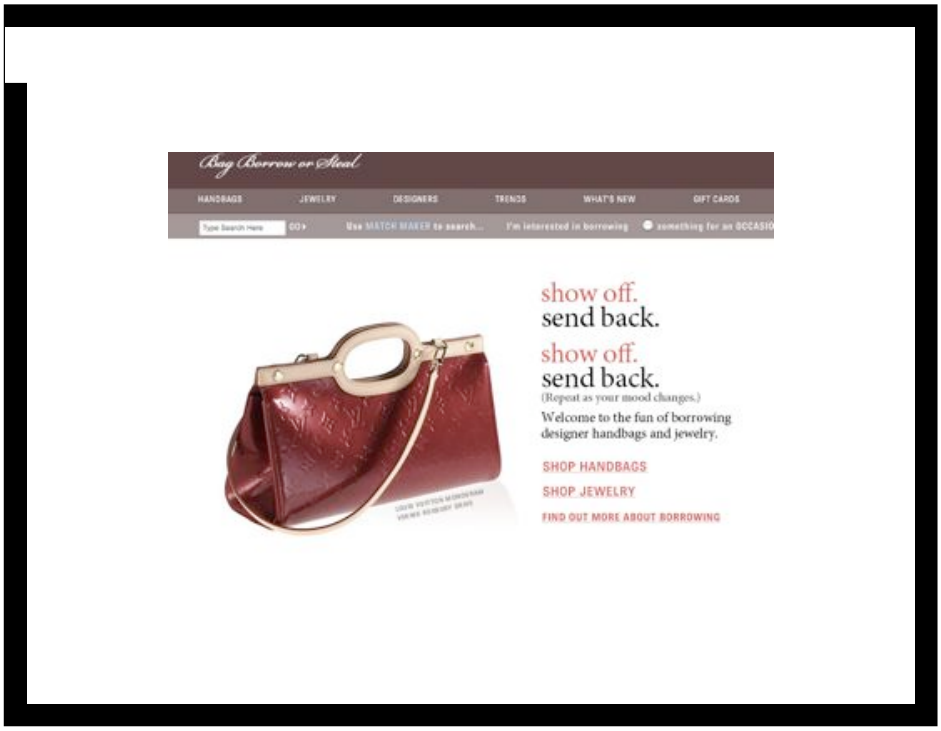
When you buy into their service, you get a dotted line car and a key fob that has an RFID in it. The car is connected to a central network. You can only open the car and start the engine when your specific keyfob is scheduled to open and start it. It uses a GPS to track where the car is, whether it's been dropped off at the right location, and how far it's been driven. All of that is transparent to you, the owner of a membership. You treat it much like your own car and have access to it 24 hours a day, 7 days a week, with very little advance notice. It's of course different than your own car--you can't leave your CDs in it and you may get a different vehicle every time you request a car--but it's certainly a lot more like your own car than a rental.

However, unlike a single car, it's a car possibility space. This is an ad from Zipcar, a similar service to City Carshare and it shows the implicit power of this kind of system. It shows how your relationship to your car can change if that car is a dotted line object.

Here's another example: Germany's Call-a-Bike program run by the rail service. The program is completely based on ubiquitous computing technology. You need a bike, you find one of these bikes, which are usually at major street corners. You use your mobile phone to call the number on the bike. It gives you a code that you punch in to unlock the bike lock. You ride the bike around and when you've arrived, you lock it. The amount of time you rode it automatically gets billed to your phone, by the minute.

Every piece of this bike had to be redesigned to satisfy its role as a subscription service.

Photo CC by probek, Flickr.



Here's another example that's not technically ubicomp, but points to some exciting possibilities. Bag, Borrow or Steal is a designer purse subscription site. It works like Netflix, but for really expensive handbags.

It's fashion by subscription and it again points to a new way of thinking about everyday objects. It changes the meaning of ownership and it changes the incentives in the design of everyday objects in a profound way.

Here’s how information shadows and trackable objects relate. The shadow of an object allows it to be automatically tracked and managed so that it can become an instance of a dotted-line object. In other words, it's the trackable metadata of physical objects that allows for their efficient conversion to services, to subscriptions.

Photo CC by bs70, Flickr

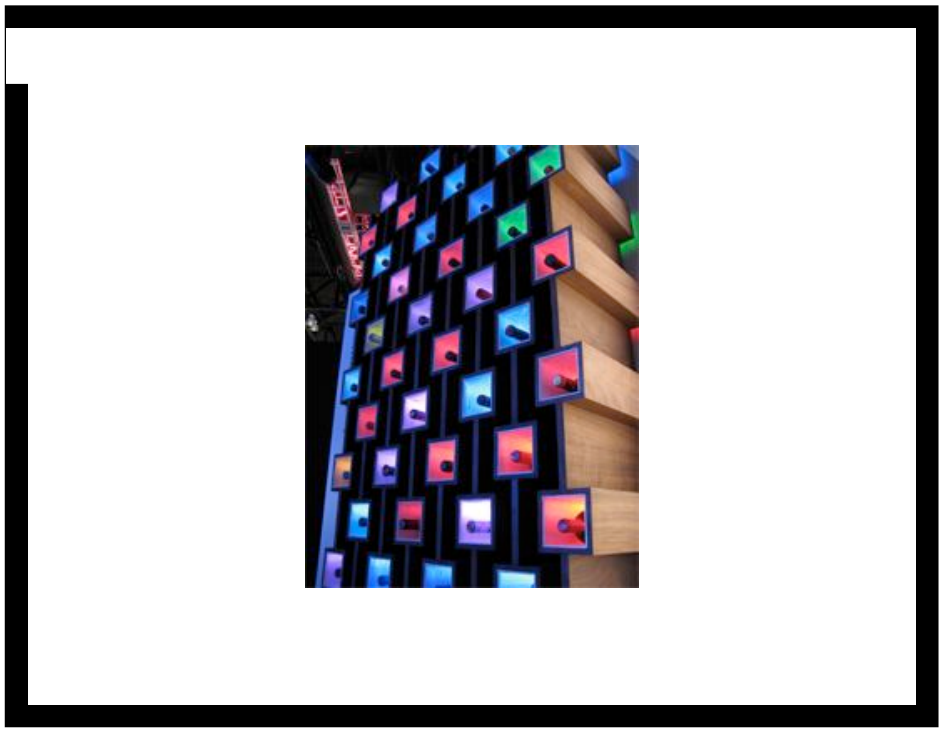
Yahoo!’s Tom Coates, who--among other things is responsible for their Fire Eagle geolocation service--called this the age of point-at-things. What he meant by that is that first we learn to digitally point at a thing's information shadow, then we can glue information handles to it, we can give it an API. Once the shadow has handles, we can grab and throw the information around.

That fundamentally shifts our relationship to what an object is, to what ownership is. We can now have the paradoxical situation where we have mass customized objects that are look identical, but exhibit entirely different behavior because of their information shadows. Or objects that are unique, but instantly recreateable.

Photo CC by lovestruck, Flickr.

This points to a fundamental change in the nature of everyday objects and of their role in society. As information processing as a material creates the possibility for new things, item-level tracking dematerializes familiar things. It simultaneously opens great possibilities and raises deep questions about ownership, privacy, design, experience, identity. Our roles change to being clusters of trackable things, and as trackers of things, as users of devices made with information processing and parts of systems made with it.

Photo CC, found on http://www.flickr.com/photos/antara365/823844803/

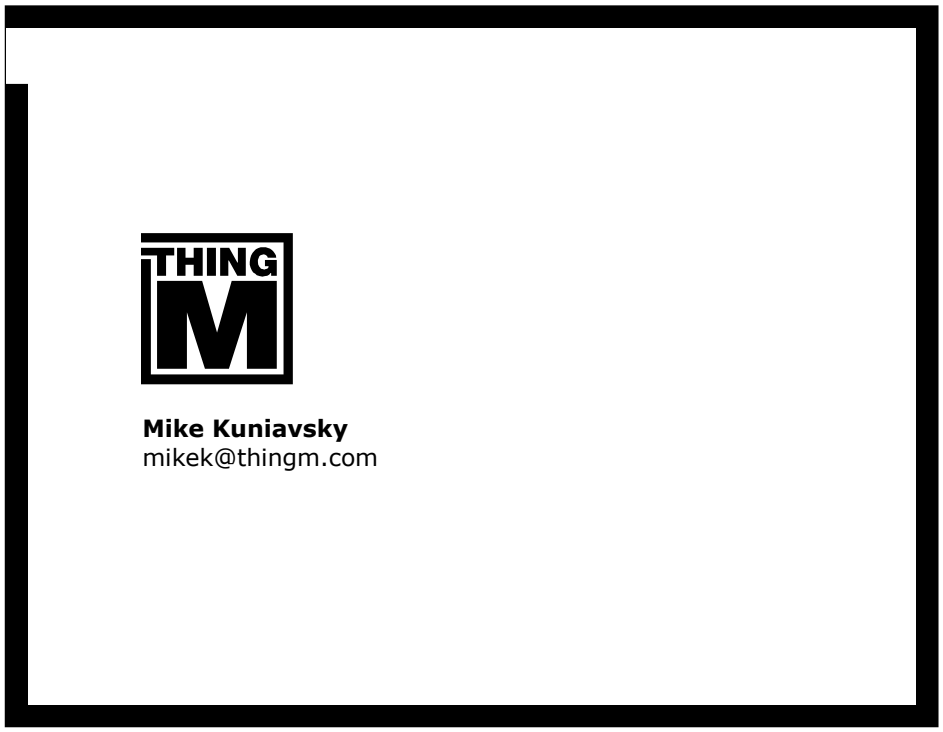


This is one of my company's proects. It's a prototype smart wine rack that uses RFIDs to connect bottles of wine to their information shadows and then to project information about the wine back onto the wine itself, so as to not interrupt the experience of selecting and drinking it. It can do all of the standard database things like show you just the Napa 2003 Cabernet Sauvignons, but it can also display which wines are ready to drink, or if anyone in your social network has a similar wine collection, or if the winery is having a sale. It's a platform for mashups of wine information shadows with the wine bottles themselves.

I'm showing it here because I'm proud of it, but also to say that as designers, we are in territory that is so far beyond the traditional human factors of usability engineering that it's like being in a different world. What we have to consider is no longer just the screen, which is complex enough, but to cross disciplines to industrial design, service design, and social media design.

The only way that we can do that is by staying true to the core values of good user experience design, of being the ones who negotiate between the needs and abilities of people, the needs of companies and organizations, and the needs of society as a whole. Our role is, to quote the great Herbert Simon, not to concern ourselves primarily with "how things are, but with how they might be."

Photo by Tod E. Kurt



Thanks!