**PRODUCTS ARE SERVICES**
HOW UBIQUITOUS COMPUTING
CHANGES DESIGN

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Good evening! Thank you for inviting me. Today I'm going to talk about how products and services are merging as a result of cheap processing and widespread networking, and how these technologies are changing everything from our relationships to everyday objects, down to the shapes of the objects themselves.

**1994**

First, let me tell you a bit about my background. I'm a user experience designer. I was one of the first professional Web designers in 1993, where I was lucky enough to be present for the birth of such things as the online shopping cart and the search engine. This is the navigation for a hot sauce shopping site I designed in 1994.

I'm proud of the fact that 16 years later they were still using the same visual identity.

Here's one of my UI designs for the advanced search for HotBot, an early search engine, from 1997. If you're wondering why Google's front page was so stripped down, I think it was because we did this.

I also helped in the design of hundreds of other sites.

And 2001 I co-founded a design and consulting company called Adaptive Path.

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.

I left the Web behind in 2004 and founded a company with Tod E. Kurt called ThingM in 2006.

**2007-2011**

We're a micro-OEM. We design and manufactures a range of smart LEDs for architects, industrial designers and hackers. We've also done a range of prototypes using advanced technology. Here's an RFID wine rack we did in 2007. It shows faceted metadata about wine projected directly onto the bottles.

2005-
2010

Because self-funded hardware startups are expensive, I've simultaneously been consulting on the design of digital consumer products. Here are some for Yamaha, Whirlpool and Qualcomm.

2009

I even still do some strategic web design as a user experience director. Here's the homepage for credit.com, who were great clients a couple of years ago.

NOKIA
CONF
2009-
2011

The last couple of years my clients have been large consumer electronics companies. I can't tell you who they are or give you any details about the projects.

This talk is based on my most recent book, which is on ubiquitous computing user experience design. The book is called "Smart Things" and it's published by Morgan Kaufmann.

Three days ago, BERG London, which is a design consultancy, released this product. It's called Little Printer, and that's all it is. It's a little printer. It doesn't connect to a specific device. Instead, it connects to the cloud to print things from Twitter, FourSquare, The Guardian newspaper, etc. It doesn't need to be plugged into a network connection and it doesn't have an interface that looks like anything we're familiar with. It's not designed to print out your Word document. Instead, it's designed to give you a feeling of what is happening in your digital world. They describe it as more like a family member than a tool. What does that mean? Is it a joke? It's not a joke. They're totally serious.

We're going to see many more objects like this, digital things that don't look or behave like the computers we're familiar with. Tonight, I want to talk about the underlying forces that are coming together to create them and I want to encourage you to start thinking about interaction design not as something that happens on boxes with screens, but as something that brings together the physical and and the digital.

I want to start by talking about unboxing. Many of you have probably seen unboxing videos or followed along a sequence of photographs as someone unwraps a device for the first time. Here's an intentionally old unboxing sequence I found on Flickr. It's from 2007.

Let's step back and think a bit about why this is interesting.

Unboxing is the documentation of the intimate experience of savoring the first time a person got to physically use, to touch, to own their precious new device. You, the viewer got the vicarious thrill of seeing someone else's intimate experience.

The act of unboxing is a kind of a devotional act to the physical form of a digital object. We have grown up in a world where the physicality of objects matters. We want there to be meaning in the form of an object, in how it looks and feels. We want to experience it with our hands, not just our eyes. We want to know what the skin feels like, how heavy it is. Is it warm, cold, hard, soft? These things matter.

Photo: Brian Yeung

Five years ago, when that first set of photos was taken, the form factor of devices was still very important. We were at the peak of form factor experimentation. The basic value of mobile phones had been established and handset makers began to compete on the physical experience of their devices. The way that the device was shaped, how you held it, how it looked mattered.

This is the Nokia 7280 and the Philips Xelibri 4, both of which come from this era.

However, something happened along the way. The unboxing became pretty boring.

Today, when we look at unboxing images for the latest products, they're all look basically the same. They're black rectangles in various sizes. Sure, each Android handset manufacturer has their own Android skin to make their black rectangle look different, but ultimately the physical objects are all trending toward the same size and shape.

Why? What happened in the last five years to change objects from these different, complex, sensuous to flat black rectangles that all do the same thing?

What happened is that our objects have become less important than the services they represent. This shift in value, from physical objects to networked services is huge and profound. It means that many of the physical things we've taken for granted are rapidly changing, new things are being created and our relationship to our world is rapidly shifting.

The shift of device focus to services represents a shift in the way that we relate to our things akin to what happened during electrification.

If you've ever used a wind-up record player or a treadle sewing machine, you know the wonder of the experience of a machine that's doing something complex, but doing it completely without electricity or gasoline. Those two substances, electricity and gasoline, as like modern magic. You don't really experience how they work directly. You can only see the effects that they have, so our relationship to electrical and gasoline-powered devices has an inherent leap of faith that somehow, somewhere inside the windings of a motor or in the pistons of an engine this invisible magic happens and the device works.

When you see a complex device that works on purely mechanical means, one that requires no magic substance, there's a feeling of incredible wonder, since your dependence on assuming the magic of electricity and gas is revealed.

That feeling is exactly the feeling our children will have about objects that aren't connected to the network.

Our children will say, "Wait, you mean your cars didn't automatically talk to

The simplest place to start thinking about this change is by looking at how expectations for user experiences on networked devices has shifted in recent past.

When information processing and networking were expensive, computers had to be general purpose devices that had deal with almost every situation. All the value was local. It was in the machine in front of you. That one tool was designed to cover every possible situation.

The software that ran on these computers also had to cover every possibility. The tools had to be completely generic and cover every imaginable use case.

However, that's no longer the case. Today processing is cheap. Our generic tools have become fragmented. The generic tools have been broken into pieces and rather than buying one generic tool, you now have a tool BOX for the same price of that one expensive device ten years ago.

That device is also not isolated. Widespread networking and the Web created a shift in people's expectations. Today, most people understand that the experience you see on one device is often a part of something that's far away, that's connected to the world through some kind of digital back channel. There's no longer a need to pack all possible functionality into a single piece of software, and there's no expectation that everything will be there.

Moreover, we are increasingly accepting that the experience we get when we pick up a device and start an app may not be like the experience we had last time. The content or the functionality of a device is no longer stable, it's fluid and it's often not under our control. The device is no longer the container of the experience, but a window into it.

In other words, widespread networking has shifted our expectation of value from the device to the information that it contains, from the local to the remote.

If we take those shifts to their logical conclusions, we see that as information moves to the network, an individual device is no longer the sole container of the information. The information, and the value it creates, primarily lives in online services.

Devices become what I call "service avatars." A service avatar is a representative of a service, and a conduit for a service. You can give the device away without giving away the service. You can change it without changing the service. You can turn it off without turning off the service. None of that was true when the value was local.

For example, let's look at digital photography.  If we take Flickr as our service, we see that a camera becomes a good tool for taking photos for Flickr, a TV becomes a high resolution Flickr display, and a phone becomes a convenient way to take your Flickr pictures on the road.

We now increasingly see THROUGH devices and software to the cloud-based services they represent. We no longer think of these products as being places we visit online, but services that we can access in a number of different ways, unified by brand identity and continuity of experience. We used to think of the Internet as a place we visit, now we think of it like we think of as the atmosphere, as something that always around us. We don't have to visit it. In fact, we're surprised when we don't have it.

For example, you can now get Netflix on virtually any device that has a screen and a network connection. You can pause a Netflix movie on one device and then upause it on another.

Because to the Netflix customer, any device used to watch a movie on Netflix is just a hole in space to the Netflix service. It's a short-term manifestation of a single service. The value, the brand loyalty, and the focus is on the service, not the frame around it. The technology exists to enable the service, not as an end to itself.

Netflix appliances are created for a single reason: to make it easier to access Netflix. That's what Roku does. It turns any device that's not already Netflix enabled into a Netflix avatar. The Boxee box does that for the Boxee service.

Here's a telling ad from Amazon for the Kindle, which is one of the purest examples of a service avatar based user experience. This ad is saying "Look, use whatever avatar you want. We don't care, as long you stay loyal to our service. You can buy our specialized device, but you don't have to."

Bezos: Kindle Fire Is An End-To-End Service

By Erick Schonfeld

The Kindle Fire may be poised to win the Android tablet wars, but Amazon (AMZN) CEO Jeff Bezos doesn't think of it as a tablet. "We think of Kindle Fire as an end-to-end service," he told me yesterday in an interview after his presentation, picking up on a theme he introduced

Jeff Bezos is now even referring to Kindle Fire in exactly these terms.

Facebook and HTC have now partnered to make a Facebook-specific phone from the ground up. If Facebook is the primary service you use on the Net, why not have a specialized device for it?

My favorite example of a dedicated hardware avatar is still Vitality Glowcaps, which is a wireless network-connected pill bottle that's an avatar to Vitality's service for increasing compliance to medicine prescriptions. When you close the cap, it sends a packet of information through a mobile phone-based base station to a central server and it starts counting down to when you next need to take your medicine. When it's time, it lights up the LED on the top of the bottle. That glow is the simplest output as an avatar of the Vitality service. The real power is in the packet of data it sends. That packet opens a door to sophisticated experiences that transcend a single piece of software or a single device.

For example, another avatar of the Vitality service is an online progress report that can be used interactively or delivered by email. It's like Google Analytics for your medicine.

Health care practitioners get yet another avatar that gives them long-term and longitudinal analytics about compliance across medications and time.

To me, this kind of conversation between devices and net services is where the real power of The Internet of Things begins.

Vitality has developed a complete system around this service that includes a social component, and different avatars for patients, patients families, health care practitioners and pharmacies. Each avatar looks different and has different functionality, but they're perceived, and designed as a single system.

Our ability to digitally track individual objects, like pill bottle caps, and connect them to the internet is creating a profound change in our physical world. We can now take what we've learned in the last ten years about creating networked experiences and moving that to physical objects.

Today we have the technical ability to uniquely identify and track even the most disposable objects. This is a melon that's uniquely tracked using a sticker from a company called Yottamark. Their service tracks each individual melon back to the farm where it was grown, through every warehouse and truck. You can use this check to make sure that it's fresh and that it was kept in appropriate conditions and that the farm is genuinely the organic farm that's advertised.

Once you know what kind of melon it is, you can also automatically find out how to cook it, how to compost it, what recipes work well with it, what your friends think about it, etc. In other words, you can do the things with it that are familiar with digital content, but now with physical objects.

Source: Yottamark

I call this cluster of data on the internet about a specific thing that object's information shadow. Every object and every person casts an information shadow onto the internet, onto the cloud.

In a very real sense, once you can identify each individual melon, it becomes the avatar of a melon service that provides information to you as a consumer, allows the store to understand their logistics, and allows the farmer to understand patterns of production and consumption. In the same way that data about yourself changes your behavior, as Chloe talked about yesterday, data about the objects in the world changes the world.

## EXAMPLE: EVERYTHING BY SUBSCRIPTION

Wrapping your brain around what this means can difficult, so let me give you an example.

When you buy into a car sharing service such as City Carshare, Zip Car or Zazcar in São Paolo, you subscribe to a service. Each car is an avatar of it's respected service, actively connected to the service at all times. You can only open the car and start the engine if the service allows it. The car logs 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 subscriber.

It's a lot like having your own car. It's available 24 hours a day and you can just book one, get in it and go. However, your relationship to it is different than having your own car.

Instead of a car, what you have a car possibility space that's enabled by realtime access to that car's information shadow.

This is the German Call-a-Bike program, run by the rail service. 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.

Each bike is an avatar of the bicycle service. Instead of a bicycle, you are now interacting with a transportation service that exists in the form of bicycles. You are not getting a thing, but the effect that the thing produces.

Photo CC by probek, found on Flickr.

Here's another example that points to some exciting possibilities. Bag, Borrow or Steal is a designer purse subscription site. It's a service for expensive handbags. You don't normally carry a super expensive handbag all the time. You want it for a weekend, or for a couple of days. Through this service you subscribe get the latest purse delivered to you. You use it for a couple of days, or for however long you want, and mail it back. Next time, they'll send you another one.

Again, what you own is not an object, but a possibility space.

Photo CC by bs70, Flickr

Here's another one called Rent the Runway that also does dresses and accessories.

Exactitudes®

58. Toppers - Rotterdam 2002

How long until you get a subscription to Zara and instead of buying your clothes, you just pay a monthly fee to get whatever is seasonal for your type of work in your part of the world at your price point.

We already have Exactitudes and people seem quite comfortable with it. Why not turn it into a subscription business model for clothes?

**SERVICE AVATAR
INTERACTION CHALLENGES**

For me, the process of creating a successful product is not limited to creating great visual experiences, or efficient, clear interfaces, but understanding how to make products fit into people's lives today and tomorrow.

When designing service avatars, a number of different design disciplines—service design, industrial design, visual design, even branding—come together and affect how we interact with avatars.

Since this is an interaction design conference, I wanted to identify some issues with service avatar interaction design to give you a feel for what the challenges, and interesting opportunities are.

The first challenge is figuring out what an avatar won't do.

When anything can do anything, when any avatar can computationally perform the same action as every other, you get a kind of design vertigo. What should THIS product do? What makes it different from that one?

A watch is a 20 centimeter interface, a phone is a A 50 centimeter user interface, a TV is a 3 meter UI. They're completely different, but app designers, people who are making these terminals into avatars, are tasked with designing a consistent experience across all scales.

It's a nightmare.

To me, this means that one of the biggest service avatar interaction design challenges is deciding what a given device is NOT going to do.

But saying no is really hard. As Chloe talked about yesterday, consumer electronics companies add the equivalent of a tablet PC to the front of a refrigerator because it's technically easy. The problem is that they don't think through how this computer will make the refrigerator a better REFRIGERATOR.

If we think in terms of networked devices, we encounter the question of how a service avatar of an online service make this fridge better? When Chloe presented her idea, she was absolutely correct in focusing on having the fridge know what food is in it so that it can become the avatar of an online grocery store service. The key insight is to create a service that focuses on what the fridge does, not what a computer can do. The challenge is to make the fridge an avatar to the service, not another general purpose computer that has to be managed.

As we've seen, no consumer electronics company has managed to do this successfully. I've been thinking about this for a long time and joking about it as a repeated failure. However, as I was writing this in the hotel room today, I realized that there is a model for this service that might just work.

It's the Hotel Mini-bar. So, Chloe, if we can figure out how to convert this this model to something that everyone will want to have in their house, we've got a huge business waiting for us. Let's talk.

More practically, the Nest thermostat is a smart home thermostat that's an avatar of their online service. Yes, as a computer it's probably computationally the equivalent of an iPod Nano, but they're not trying to make another random small computer stuck to your wall. Instead, it's a networked thermostat. It doesn't do ANYTHING except try to be the best way to keep comfortable and save energy, using its status as a service avatar to do that.

They could have made it an invisible box that you control through an Android app, or a tablet that hangs in your hallway, but why? It's much easier to think of it as a thermostat. It's focused on the context in which it's used.

They also have other avatars for the same service. Each one is focused on maximizing the value that's possible in the context in which it's used. What is good about a computer with a high resolution screen? Well, you can use the large screen to see a complex schedule on it. The designers used the affordances that are available in the way that makes sense given what people want to do in context in which the avatars are going to be used. It sounds like straightforward user centered design, but it's surprisingly confusing about what the right context is, where the right places to say no are, given everything that's possible.

A second key interaction challenge deals is how to manage service avatars ability to behave on their own. When you had an unconnected computer on your desk, or a simple feature phone, you were pretty sure you knew what it was doing most of the time. The more connected a device, the more it does things without asking you, without you knowing. Designing interactions with devices that have their own behaviors is quickly becoming a significant interaction design challenge.

Let me give you a simple example.

This is the Water Pebble. It's a shower timer that aims to reduce water usage. When you first use it, you push a button and take a shower. From then on it glows green while your shower time is fine, yellow when you're almost done, red when you should stop, and blinking red when you're really over. The interesting part is that, after a while, it starts slowly reducing the amount of time it gives you so that you progressively build a habit of using less water.

My personal experience with it, however, is that its algorithm for behavior change doesn't match my ability to actually change. It reduced the amount of time it gave me to shower, and I was following along with it, until my change curve deviated from its. Instead of helping me change my behavior, it just sat there at in the shower drain blinking red and mocking me for not being good enough. I couldn't reason with it, I couldn't get it to change its algorithm to match my capabilities, so I stopped using it.

The interaction design challenge is how to let a user negotiate with this device that's making decisions for me. This is a simple ubiquitous computing device, but what if it was a service avatar that controlled the actual amount of water I used. I would now need to negotiate with

You can see how iRobot solved this with their Roomba robotic vacuum. They initially gave you four different ways, four different buttons for selecting what kind of mission the roomba was supposed to go on. Of course the robot can do much more than that, but they watched people use the robots and determined what kinds of activity was most requested, what kind of behavior you could expect from the algorithm.

Then they revised it based on further research, essentially down to one button.
That's not minimalism for the sake of minimalism, it's saying no to
functionality based on an understanding of context.

The next interaction design challenge is how to deal with interactions with data streams, rather than data files. Traditional computer devices produce files, and over the last 30 years we've developed a number of different mechanisms for dealing with them. Today's modern file browsers resemble search engines more than they do the original Mac Finder and that kind of works. It's not great, but it's functional.

Service avatars, because they're autonomous networked devices, do not produce files. Their basic unit of data in a service is the data stream. They produce continuous streams of information, rather than single units of information. Think of it as a change from a world of static Web pages to dynamically generated sites. It's a completely different design philosophy.

Here's Pachube, an online data brokerage for what I would call service avatars. Each one of the 80,000 devices is producing a continuous real time stream of data.

How do you manage one of these? How do you manage twenty?

I think that the financial industry is a great place to look for models for dealing with data streams. Money is one of the oldest services with lots of well known service avatars from credit cards to ATMs to online shopping. There are a lot of good services out there that have very good interactions with streams of money. Mint.com collects the output of a number of different financial data streams and gives you lots of ways to see trends and to control what happens where.

Let's think of streaming video subscriptions. When people are subscribed to twenty different streaming video services, how do you help them manage that? Perhaps the answer is that we should start interacting with all service data like we interact with money.

Finally, we hit the last major interaction problem, which is that these devices can technically work together well, but in practice they're all separate. How can you design these avatars so they use their power and work together to make your life easier? How can you bridge devices to create a single experience that crosses multiple devices?

We're now starting to make headway, most notably in what's called "second screen" user interfaces. The TRON Legacy Blu Ray, for example, has a companion app that listens to the soundtrack and synchronizes interactive content on a second device along with the movie. These are essentially two avatars for the same service, which is the delivery of TRON Legacy. This is the beginning of multi-device, multi-screen user experiences.

Again, we're at the start of figuring how interactions can span multiple devices that are simultaneously working together. Very soon as we have toolboxes of devices, rather than individual all-purpose devices, we're going to have to hook them together, and that's a fantastic interaction design challenge.

Image from Disney.

# THE SHAPE OF AVATARS

The last thing I want to talk about is the most speculative. I want to talk about the shape of service avatars.

Shape is a key component of the user experience, I'm really interested in how the physical shapes of objects change when they use new technologies, and I think we're about to see a big shift in the shapes of the objects in our world.

Let's start with telephones.

The old phone network was one of the first avatar-based services and you can see the effects of that relationship on the physical design of the devices.

If you look at an old phone, you see that it's not built for fashion or for flexibility. It's built for the most common use case and it is built not for annual replacement, but to minimize the need for repair. It is simple and modular and its internal parts didn't change for decades. It is a very conservative product design, for better and for worse.

The minute that phones stopped being owned by the service, they stopped being service avatars and became normal products, their shapes went crazy and the manufacturing quality became incredibly cheap because the entire set of incentives in the design of the device was different.

As we move back to a world of more service avatars, we can see this pattern repeating itself.

Municipal service avatars, the familiar Internet of Things devices such as smart electricity meters and networked parking meters that are being deployed by governments and utilities in large quantities, are very conservative for all the same reasons as the original phones. That's not so surprising.

What's surprising is that because the designers of Call-A-Bike bicycles had many of the same design constraints, constraints that are inherently imposed by the economics of centrally-controlled services, they made the same kinds of decisions. The Call-A-Bike bikes are different than any other bike on earth, but because they are robust, overdesigned, easily repaired they may also be the most conservative.

Does this mean that this is the case for any service avatar design? That the design philosophy has to be ultraconservative?

No, but the other direction is not pretty, either.

Before the advent of LCD TVs the replacement cycle of a CRT-based TV was on the order of 10-15 YEARS. Today, you can see that as the price of LCDs drops on the order of 20% per year, so people are replacing their TVs much more quickly.

**Vizio tells owners their sets are unrepairable**

*By Gary Merson*
*HD Guru*

Vizio, America's second best selling LCD TV brand, is now telling some owners of broken sets that their televisions cannot be repaired. If the set is past the 12-month factory warranty, Vizio advises owners to buy a replacement set from the company.

HD Guru came across Jeff Bartran's letter to Vizio CEO and founder William Wang complaining that the company's service department had deemed "unrepairable" his 13-and-a-half-month-old, high-end $1868 Vizio 55-inch LED LCD. Bertran says Wang never responded.

This affects how the TV is designed and built. As prices fall, margins shrink and the build quality starts to go down because there's an expectation that consumers will replace the device soon.

Vizio, a low-end TV maker, now regularly tells people that they must replace their TVs if those TVs are older than 12 months. Instead of a 15 year replacement cycle, Vizio is working on a 12 MONTH replacement cycle for TVs.

In other words, like the Garfield phone, when you buy the avatar of a service, you are just buying a frame. Thus, the design incentives are to make it as cheap as possible with gimmicks, because the makers know there is no real value in the avatar, it's all in the service.

Neither of these options is appealing to me. You either get conservative or disposable. That's a bad choice. If we had a Zara clothes subscription service, does this mean that their choices would be to build clothes that were built like tough work clothes or made of paper?

I hope not.

As I said, in the opening, the physicality of objects matters. I think that the answer is for us as designers to reinvent business models. We are the ones who have the tools to satisfy consumers' desire for self-expression, elegance, variety and functionality, while still making products that are designed to be useful for many years

It's the beginning of a profoundly new world, with these emerging technologies shaping the objects in our world, our relationship to those objects and how those objects are changing our expectations.

Because we are interaction designers, we will be the people designing the devices, the services and the world. We have a great responsibility.

We, those who grew up on the net and who design it, will be the ones who create ubiquitous computing, not the roboticists or network engineers, and ubicomp will fundamentally change the world and us along with it. Like Jon said yesterday, it is our responsibility to use our knowledge of people and technology to create new business models, to start companies, to take huge risks, and to be thoughtful about the implications of what we're doing without ever forgetting that we have no idea what's going to happen next.

Shelf by Jean-Louis Frechin
Floor by Enteractive
Buddy Beads by Ruth Kikin-Gil
From Herman-Miller's "Always Building"
TU Delft's Interactive Environment project
Usman Haque's Sky Ear
Hello.Wall

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Thank you.