Computing Becomes Decentralized

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Background

Traditionally computing has been focused on people interacting with a single device to access and manipulate locally stored data. As technology evolves it is becoming more decentralized in regard to storage, run-time code, processing, input, output, and number of users. With the pervasiveness of smart phones, next generation game systems, rich web apps, and smart consumer devices data storage has moved from local hard drives to servers. Run-time code has moved from compiled local applications to web applications. Processing has moved from client side to server side. Input has moved from a single mouse and keyboard to multiple devices controlling shared displays and devices. Output has moved from wired external displays to shared virtual environments. Control of devices that were typically single user has moved to multiuser.

User experience is no longer single focus. It encompasses all the devices within a user’s ecosystem. This includes their TV, their phone, their laptop, their desktop, their tablet, their game system, their friend’s phone, their pedometer, their projector at work, their car, and more. As we design and develop next generation user experiences it is imperative that we consider the whole user experience and design for distributed input and output across the user’s diverse device ecosystem.

The Latest Trends

Web apps start to displace client apps

We are seeing a trend especially on desktop and laptop PCs where rich client applications are displaced by Flash and HTML5 web applications. These sites or web apps are approaching the quality and feature set of their client software counterparts. In the Google Chrome OS example below applications come in the form of websites that have offline modes akin to how Gmail currently works with Gears. Updates don’t have to be downloaded and installed. Through standards like HTML 5 and Flash development needs only happen once and can bring the product to many platforms.
Local data storage and retrieval is displaced by decentralized storage and retrieval
More and more services are streaming content rather than downloading content. Netflix and Pandora are ever expanding their device support and streaming content libraries. Comcast OnDemand, GrooveShark and YouTube are also leading providers of streaming content. As communication becomes more decentralized through higher bandwidth cellular communication there is less need for local content on mobile devices. These streaming services allows user’s access to more data than could fit in local memory. And the persistent connection to the Internet makes an opportunity to share control between the provider and the user (Pandora).

User content is also seeing a massive shift from local storage to web storage. Photos are uploaded to web services from smart phones bypassing the classic upload to PC experience. This has displaced the point-and-shoot camera market.

“While smartphone sales in the United States continue to skyrocket, unit sales of point-and-shoot cameras fell nearly 16 percent since 2008, according to the market research firm NPD Group.” -NYTimes Article

Personal devices work together with shared devices to create a decentralized user experience
The promise of ubiquitous computing is one step closer to being realized: phones control TVs & PCs; tablets control shared music players; games are played together with multiple devices working in unison. The glue that holds our devices together has never been stronger and is leading us to a world where data, control, and visualizations bleed seamlessly throughout our device ecosystems.
Scrabble launches a $10 app for the iPad that uses iPhones as private display.

Pad Racer for iPad and iPhone use the accelerometer on the paired iPhones to steer multiple cars on the iPad(s). Multiple iPads can be networked together to make larger connected tracks.

Sing-a-ma-jigs distribute the play experience across multiple singing dolls. They can sense each other’s presence and activities in order to talk to each other, and harmonize with each other.

Face2Face Hold’em allows multiple users to play Texas Hold’em together around an iPad using their Android or iPhone smartphones as private displays.

Ping Pong Battle uses iPhones as paddles and an iPad as the table.
Air display for the iPad and iPhone allow a shared desktop between a PC and iPad or iPhone with minimal compression artifacts and lag. Multi-touch input is also accepted on the touch display for dragging, tapping, panning, and context menu.

Mobile Mouse Pro for iPhone allows people to control their PC or Mac with their phone. Features include multi-touch trackpad, keyboard input, number pad, media controls, application launching, and an accelerometer motion control mode.

The Leanback controller on iPhone and Android allows people to control any device playing YouTube videos on www.youtube.com/leanback. Trust is acquired by both devices being logged into their Google accounts.
Media playback control is decentralized and shared between users
No longer does one person control a media experience. Simultaneous shared interaction is becoming the norm for many media products.

Devices become accessories for your phone
Our phones have become the glue that holds our device ecosystems together. Cars have become the most expensive accessories for your phone. Most luxury cars and many mid-level cars have become expensive accessories for your phone through Bluetooth voice call and media playback. Hands-free call laws across the globe have given rise this trend.

 Tablets are set to use your phone as the primary connection method. The upcoming BlackBerry tablet (pictured below) uses a Bluetooth connection to a BlackBerry phone as its on-the-go method to access email, messaging, calendar, tasks, and documents. Artefact assisted RIM to envision the **The BlackBerry tablet**.

Cameras could become phone accessories. As seen in Artefact's **Camera Futura** cameras could themselves become decentralized and smart lenses could be used to extend the phone's function to include professional grade photography.

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**Sonos** music players can play in multiple rooms and can be controlled simultaneously by multiple controllers. Desktop, iPad, iPhone and Sonos controllers currently supported

One of many 'social viewing' products. **View2Gether** users vote on what video should play next in a shared playlist

**Honda Bluetooth phone controls and BMW iPhone dock**

**RIM BlackBerry PlayBook + BlackBerry smartphone. The upcoming BlackBerry Tablet**

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**Amplify your BlackBerry experience**
Pair BlackBerry® PlayBook™ with a BlackBerry smartphone* via secure Bluetooth® connection for full access to:
> Push technology
> Email, calendar, BBM™, tasks, documents and more
> BlackBerry security and data efficiency

*The momentum certainly seems to be there.* - LAPTOP
Opportunities

Design your user experience across devices
Allow a user to start their task on their phone and finish it on their laptop or tablet or vice-versa. Allow an onlooker of someone on their laptop to tap on hyperlinks and bring them up on their phone’s browser. Distribute control and playback of media across multiple phones. Make a single version of your application that works on all platforms of similar input method. Ditch the mouse or remote control to replace it with the user’s phone.

Establish a secure standard for sharing data across all devices
DNLA is the current standard for sharing media between devices. This covers many scenarios around distributed media playback and control. Sharing data other than media can be more cumbersome and has not standardized. Wifi, Bluetooth, near-field-communication, are all options for developers. Without a secure standard for sharing data like location, accelerometer data, or touch input between devices, developers have to do it differently for all device combinations. Until a standard for trust and pairing is established decentralization of control will not mature fully. Long term I think the best pairing method for people will be proximity. Bump is a good example of this. American Express Pay cards or Visa payWave cards are another. But why standardize if you are a company with a large device ecosystems? An advantage for a company that has a large ecosystem of devices is that this pairing is easy and constant for their developers and users. But it is also stifling the entire ecosystem of devices by alienating people who have a combination of device brands in their ecosystem. For example it is difficult if a Windows Phone app wants to share accelerometer data with an iPad app. A competitive advantage could be that you work with everything and can distribute your experience across a wide range of devices, and not just one or two.

Create extender applications
Setting up distributed experiences can be laborious and tedious. For the game Ping Pong Battle you need to download three applications. One on the iPad and one for each iPhone. There is an opportunity to create an application that can download UI from any paired device at run-time. The UX could look like this: 1) run the Ping Pong Battle game on the iPad, 2) run the iPad extender app on iPhones, 3) accept the pairing and download the paddle code on the iPhones, 3) trust is established, the paddles are displayed on the iPhones and accelerometer data is passed from the phones to the iPad. A single application on each platform could create this connection for all device combinations. Then our devices don’t have to be filled up with half applications. Nintendo DS download play is a great example of this pattern.

Exercises

When designing your product, ask yourself these questions. If you are designing a PC experience how can you take advantage of your user’s phone’s display and sensors? How can your phone application take advantage of the car it is in? Can you use a phone as a motion controller for your platform? How can your application be better if there are two or more of the same devices next to each other? How can I decentralize the control of my experience?

You might be asking yourself, “How can I design for this evolving medium? Are they any best practices?” Many best practices in this space have come out of multiplayer games. Games have had to deal with the problems that arise from multiple users interacting with the same device for decades. In addition, here are a few principles we have followed when designing for a decentralized user experience:

1. Make it clear who is controlling what. If you are remotely controlling content it is imperative to have some on screen indicators of who is in control of which UI interface. For example you might number the players and append a matching number and color to each on screen cursor. Or you might show prompts like, “User 1 is typing…” when a remote user is preparing a written response or comment.

2. Zero perceived lag. In scenarios where one device controls another and the user’s focus is on the device they are not touching it is imperative that there is near zero perceived lag. A good example of this is Pad Racer where focus is on the iPads’ displays while control is in the phones’ accelerometers. In cases like this shoot for less than 50 milliseconds lag. In experiences like Scrabble or Face2Face Hold’em the user’s focus switches between the personal display and the shared display regularly. In this case lag time between action on phone and iPad can be longer, but should not be more than 1 second.

3. Guide user focus. Always expect the user to be looking in one place at a time and not know that they should look somewhere else. If it is important to your experience to switch focus between devices, make sure there are visual or audio cues that guide the users’ eyes.

4. Test with real people. When you are designing for something new, you will be surprised how people react to it. Seeing these reactions early can help you find hidden problems in your design. In order to get good results, make sure you are realistic as possible by using all the possible combinations of form factors. If you are using a paper prototype technique be sure to provice paper representations of the TV screens, cell phones, tablets and shared other device you are designing for. It might be as simple as drawing a big rectangle on a whiteboard as a proxy for a TV.