

FORECASTING SCENARIOS

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SCENARIO # 1: BLENDED REALITY

This is a world in which social demands serve as the primary driver for change in Internet technologies. The hardware and software—such as the browser—tend to fade into the background, and Internet companies compete more on the ability to connect users to the world around them than on features such as speed or memory footprint. The (reasonable) assumption is that all of those features will be “enough”—fast enough, small enough, light enough, etc...

Luisa Martinez stretches, trying to wake up her muscles. It's cold, it's dark, and it's too damn early to be doing this. Grabbing her run pack—her specs, her tablet, and a Nalgene bottle of water—she heads out into the San Francisco morning.

On the sidewalk, she turns on the web tablet and puts on the specs. They're new; she got them as a gift from her brother, who loves the latest gadgets. They're supposed to work with the new networks that the City is installing (yet another Google project, she recalls), as well as provide a new way of controlling her tablet (a pocket-size device replacing an old iPod she recycled a month or three ago).

She sees a slowly opening flower off to the side of her vision as the system comes online, a rose. She smiles; Diego must have done some customization before he sent it. A text crawl, just below her eye-line, asks her to confirm if she wants to use her “Jogging” profile from the tablet. She pauses—was this a voice interface?—and remembers that the specs have one of those accelawhatchamacallits in it to respond to movement. Hesitantly, she nods, the display clears, and she sets off.

It's just a five kilometer run (she still hasn't gotten out of the habit of thinking in terms of kilometers, after that year in Europe), but the weather is turning, and she wants to make sure she gets in some exercise.

As she jogs along the street, the periphery of her vision is filled with translucent icons. She doesn't pay much attention to them—she read in the manual that as long as they're transparent and over on the edge, everything's fine—instead singing along under her breath with her classic rock playlist (oldies like Good Charlotte and Amy Winehouse), following the line stretching out in front of her, the day's

semi-random path. She notices, with some mild irritation, a sudden shift in the route, the tablet telling her that she needs to cross the street now.

She looks both ways—old habits die hard—and glances over to where the original route would have taken her. Just as she suspected, that crazy guy (homeless? She hopes not) is poking through a recycling bin. He yelled something obscene at her last time she ran by him, and she doesn't want to get that close to him again.

The new path takes her closer to the park. One of the icons along the edge of her vision starts to pulse gently, and slowly moves closer to the center of her attention. Pollen counts are up, earlier this year than the last (again); it's not enough to trigger an allergic response, but it's still worth adding to her medlog.

Luisa turns into the park, and the system pops up a message asking if she wants to continue her previous route. If she's soon not going to be able to spend much time even near the park, she may as well enjoy it now. She starts to say "no," catches herself, and shakes her head. The tablet quickly recalculates a new route, one winding through the more appealing parts of the park.

The City (and Google) had spent a good amount of money over the last year or two making the park "smart," much of it in connection to some federal global warming initiative. Nearly all of the trees and larger plants have the faint band (only visible through a device like the specs) indicating a data source—probably one of those little radio tags that show up in everything.

She stops for a moment, and stares at a bush up ahead, triggering the launch of the plant's agent. She gets some basic info about the species and its history in the park, as well as how this particular plant has been responding to climate changes. It's the same kind of shrub she has in her back yard, and she noticed happily that the display is clearly a web page of some kind. She can pull it up out of the history when she gets home.

She sets off again. The day is starting to clear, and the park is looking particularly lovely.

Up ahead, as the route goes past the lake, Luisa sees a figure in the far distance ringed in a strong glow. It's too far for her specs to have made a visual ID, so it must be someone on her FaceSpace network. Staring at the glow for a second, she gets a text crawl identifying it as Eric Jackson. Oh. Hmm. She picks up her pace a little.

A couple hundred meters away, she gets an instant message pop up, with just one word:

Joust?

She laughs and nods, the specs & tablet sending the affirmative back to him. She's not sure when or where this started, but it seems like everybody (at least everybody with a thousand-dollar augmented reality setup) is doing it now. She tries to remember how to launch an application with the specs, then just stops running for a sec, pulls out the tablet and launches JoustAR by hand; she's doesn't really like voice and motion interfaces, and prefers the multi-touch screens she had growing up.

The view shifts, and suddenly the park is festooned with medieval-style banners. Glancing down at herself, she sees with surprise that she's now a centaur in armor; bending her arm into position, she now appears to wield a lance. She starts running again, towards Eric. He's gone for a more traditional human knight-on-horseback look, and is "galloping" at top speed for her. As they get closer to one another, each is dodging and weaving to get into a position to "hit" the other and avoid being hit in turn. Not that it does either any good; as with the handful of other JoustAR sessions that Luisa has played, both players get tagged. It's all only visual, so the lances seem to go right through without any actual sense of impact; using a head-mounted display, however (instead of holding up a tablet or phone), makes it seem a little bit more jarring.

Eric is laughing and smiling at Luisa as they pass each other.

She looked him up last time she encountered him while running. Single. Sober. Working on his second Master's degree. She's going to have to joust with him again.

She swings around the lake, the route now starting to bring her home. She glances up at the apartment complex across the street from the park, and is actually surprised. She'd heard about these, but didn't realize that they'd made it out here; each of the apartments has its own information glow. She pulls out her tablet, slowing her run, and does a quick search: yep, this is the second apartment building in SF to adopt the information tags, and only the fifth in California.

She glances at the apartments again. From what she'd read, each resident can choose how much information transparency they want, from completely locked-down to completely open. Most of the residents of this complex have gone for the most basic, restricted

profile glow, but a few offer a bit more: up to the minute news feeds, local environmental reports, animations of their latest NewTube productions. There's one that looks like it really belongs in a Craig's List ad.

There are two units that claim to be empty and available for rent. Luisa quickly pulls up the links in her tablet, loading the pages to check out later.

Arriving home, she does her cool-down stretches in the entry hall, looking at the stats for her run (distance, heart rate, calories consumed, oxygen intake, environmental toxin intake, the usual) with half-interest.

Taking off her specs and setting the tablet on the table, she opens the refrigerator. The tablet has already synced its data with the home system, and the wrappers on the stuff in the fridge reflect her doctor's advice as to what to consume and what to avoid right after a run. She notes these "enviro-wraps" with a mix of annoyance and resignation. Yes, that bagel looks good, but not, she's not going to eat it right now. The red star on the wrapper is clear on that; instead, she reaches for the Electrolicious (nice green circle).

Luisa Martinez' day finally gets underway.

In this scenario, the browser exists, but as the interface to a variety of Internet services beyond the traditional web. There's so much interdependence between the Internet and one's local information that there's essentially no functional distinction. Many products are now "smart," linked to the Internet and able to change some elements of their state (typically the appearance) to reflect changing data. In the scenario, both the specs and the food containers run specialized web browsers; the iPod, the park foliage, and the apartment building all run specialized (and tiny) servers.

SCENARIO #2: DAY TO DATA

This is a world in which the changes over the next decade to the Internet, and to the Browser, are driven by the continued evolution of digital technologies—a “supply push” scenario. Improving the tools that allow us to find, interact with, and control the information in our lives shapes both our commercial needs and the research agenda. The focus here is on understanding what our data means, not just innovating new ways to use them.

If you were to ask me to sum up what the last decade has meant for information technology, I'd just have one word for you: control.

Now, if you were reading this back in 2008, you might think I was talking about personal control—surveillance and privacy and the like. Fortunately, I'm not. I mean control over the information we create and use, what some folks call our “information shadows.”

These shadows are big, and just getting bigger. A decade or so ago, we supposedly generated about a hundred gigabytes (or about one-ten-thousandth of a petabyte) per year; these days, as best as the aggies can calculate, we have annual shadows of about 20 terabytes (or 2% of a petabyte). That's over the whole of the web, of course, although the new petabyte storage devices (whenever I call them “drives” my co-workers roll their eyes, and I can swear that my aggie sighs) should make it possible to carry a person's whole life in a small box.

A decade ago, however, personal storage topped out at a terabyte on the desktop, and those really *were* hard drives. That was pushing the boundaries of what the old, old-style computer interfaces could usefully control. As a result, we saw a lot of demand for help with understanding and visualizing data, and services offering data aggregation, info-markets, and social filtering started springing up all over the place. They weren't terribly smart, but they worked a lot better than what we had before.

Meanwhile, the costs of both storage and bandwidth kept dropping. By 2010, online storage was effectively free, and we were finally starting to see Wimax, G:Net and 3.5-generation wireless roll out, making mobile connections cheap and effortless (at least where available). The US was still playing catch-up to the rest of the world when it came to broadband speeds, but the Americans were slowly closing the gap. Information networks—the Cloud, the Noosphere, whatever you want to call it—were finally becoming a ubiquitous service.

On the user side, the tools for understanding our data kept getting better, too. Search engines started to be able to parse text for *meaning*, not just combinations of words. New software for creating mashups made it possible for non-technical users to do on-the-fly information combinations. And Apple's iWhisper introduced the first viable sub-vocalization system for everyday users. The tech pundits universally condemned it, of course; by the next year, most of them were using it.

The pace of change for users, however, ended up being slower than some had predicted. Making good interfaces is *hard*. The tools were in those awkward years of being enormously powerful but enormously clumsy. Security was still opaque, interfaces still had the baggage of the old windows & mouse era, and the gap between “do what I say” and “do what I mean” was still profound. It was difficult *not* to accidentally stumble across something you weren't supposed to, or lock someone out of their own datastream. These kinds of design flaws meant one thing: lawsuits. By 2012, litigation over access to or misuse of personal information hit an all-time high, and it was a pretty frustrating time to be in the industry.

The biggest user-side advance of the early 2010s came in hardware. The ZCard was the first in the line of MMDs—multiuse mobile devices—and it caused quite a stir when it hit. A terabyte of built-in storage, camera, multitouch, 4G wireless, in an ID card-size device. It worked like a phone or web pad on its own, or could serve as the core of a laptop for people needing a bigger display and better interface. It really changed everything for a lot of us; you probably have one or two on you right now.

The funny thing is, it wasn't as much of a paradigm shift as its enthusiasts claimed, at least not initially. It combined a few devices, and the modular system was cool, but it was otherwise just the latest version of a technology path that had been going on for a decade. It was only when decent wireless broadband had become commonplace—2012 or 2013 or so—that we got a chance to try something new. A few vendors started putting out ZCards that offloaded processing and deep storage to the Internet, making the cards little more than extremely smart (and small) network terminals.

Some of us old-timers shook our heads—how many companies would refuse to learn the lessons that network computers never succeed?—only to discover that this time the model worked.

Most folks attribute this to the ultra-high-speed wireless, but I think the real cause was something a bit deeper. Running mostly in the

Cloud meant being able to tap into systems that simply wouldn't work on a card. Data analysis and transformation services offered much more granular and sophisticated ways of understanding the information streams that make up our lives. Complex agent and daemon systems, building on the meaning-aware search tools of a few years earlier, allowed these services to serve as almost like an artificial subconscious, finding unexpected connections between seemingly separate parts of our data streams.

I know most of the teens using the software rely on it for hook-ups, but back in the day, it was like magic. I used to set up an iPad during meetings to do "epiphany hunting," listening to the conversation and pulling up links that it considered relevant. Not everyone was thrilled with these systems. For a lot of users, having some outside service provide an artificial sub-conscious that seemed to know you better than you knew yourself was, in a word, creepy.

Over the next few years, from about 2013 to 2016, many smart people focused their efforts on figuring out how to get the benefits of shared information streams, mashups and spooky-smart agents, without signing away the rights to our own information. A variety of partial solutions emerged. From the collaboration/open-source crowd, we got the Data Stewards Agreement, spun off from Creative Commons. From the corporate sector, we saw rapid acceptance of IBM's Data DNA system for tracing the origins and evolution of online data. The governments got into the act with the EU's data-use license model and the US Omnibus Personal Information Utilization Mandate.

None of these worked perfectly, and each alone would have failed, but the combination—with rules for sharing, tools for monitoring, and overarching regulation keeping things on a level playing field—seemed to succeed.

With that settled, a variety of new interface and information access technologies that had been sitting in the labs finally made it to the users. In late 2016, the development of contextual analysis and reference tools made it possible for software user agents and system daemons to respond more appropriately to events; these were, in effect, what we'd now call rudimentary artificial general intelligence (AGI, or "aggie") designs. The need for speedy data access and the availability of amazingly fast nano-processors meant that the "put it all on the Cloud" trend has started to shift back.

Last year's trend of wearable systems looks like it's going to be here for awhile. Some of the wearables are nothing more than remote interfaces for a Zcard, but some of the models, especially Sony's VX-

1000 (aka, the “Terminator Goggles”) give you supercomputer power on the bridge of your nose. Just don’t ask me if I think you look cool.

Personal systems like this, of course, mean that agents, daemons, and aggies don’t just live in remote servers in Mountain View, but literally right in our pockets. This has a number of advantages, but for me the most profound is having an information filter, able to make incredible connections and pull from the whole Internet’s riches, working in real time along with me. My digital system is becoming less of a tool, and more of a partner. And as much as we may have feared the rise of these machines taking away our humanity, or isolating us from one another, or stripping us of our privacy, they’ve done just the opposite. I’m more empowered, more connected, more *myself* than I’ve ever been.

I can’t wait for next year.

In this scenario, the concerns over information control emphasize the need for browsers to serve in the role of “filter,” limiting outgoing and incoming information even as they display web sites. As systems for interactive filtering become more sophisticated, eventually becoming artificial general intelligence designs, the browser becomes the interface not just for Internet access, but for broad interaction with personal and web-wide flows of information.

SCENARIO #3: OUR DATA, OUR SELVES

This is a world in which Internet technologies, and the uses to which they are put, co-evolve, with both technological innovation and social demands pushing changes. In many respects, this is the most “traditional” of the three scenarios, because the interfaces for the use of the web remain broadly similar to the present day, even as the specific uses themselves shift. At the same time, it may be the most disruptive, because of the ways in which the technologies get adopted result in some significant changes to how we see each other.

2008: The Mainstreaming of Social Networks

First email addresses went mainstream (your parents or grandparents get one); then Internet shopping became ubiquitous (your parents or grandparents start to use Amazon). Now, web-based social network sites hit the big time (your parents or grandparents join Facebook). This has the usual salutary effects: commonplace references on sitcoms; appearance on business cards for non-tech workers; discussion in the *New York Times* without an initial definition.

Many people outside of the net.hipster world start to document their lives online, via microblogging (e.g., Twitter), photoblogging (e.g., Flickr), or rudimentary lifelogging (using Nokia software). Early stumbling efforts to link social networks to commerce finally start to show some promise, but remain a sidelight. Much effort goes into figuring out how to integrate one network into another (e.g., a Second Life plug-in for Facebook).

Problems remain: there are few links between different language or cultural communities; the software and sites are still created to appeal to teenagers with ADD; no way to guarantee a consistent identity across diverse networks; and—most prominently—there’s insufficient granularity of social categories and controls (e.g., most people tend to have more than “Friends” and “Limited-Profile Friends”).

2010: Instant Karma

The first wave of social networking systems built entirely for social adults takes hold. These serve very similar roles to earlier social network sites, but rely on interfaces and tools designed to better fit the lives of people out of college, and—increasingly—people of retirement age. Facebook and the like don’t go away, but see another mass migration of people to new networks.

The more cutting-edge sites begin to experiment with shared reputation systems (aka, “karma,” “whuffie,” or “rep”). These serve as ways to declare levels of trust and reliability so that people downstream (friends of friends) can recognize potential social risks and opportunities. Several competing models emerge, none of which works very well.

Still, most users consider the concept useful, albeit rudimentary. The biggest immediate problem concerns identity, especially when a few high-profile identity spoofs make life hell for some prominent bloggers.

The continuing rise of mobile Internet tools and increased growth of retirement-aged users (often with a variety of physical disabilities) serve as engines for the growth of interface-agnostic web and information tools. This ends up being the foot in the door for cross-system communication, avatars, and identities.

2012: iSubscribe (aka, OurSS)

It has become clear by this point that the youth-oriented networks serve as beta tests for innovations that trickle up to the mainstream systems. Always-on location-awareness tools, for example, having undergone rapid design iterations towards the turn of the decade, and now mature enough for more widespread mainstream deployment. One of the first spin-offs is the growth of a “stuff-positioning-system” for the home. This is another tool quickly embraced by an aging adult population.

Reputation network pushback is well underway (including “The Great Whuffie War” of 2011). Spamming, gaming and hacking the reputation networks has become so widespread that some of the original networks have shut down, and most of the remainder have significantly limited growth as they try to fight the attacks.

One arena that offers some relief from abuse is the identity management system created by Google but made open source. Apple, Microsoft-Yahoo!, and soon most US universities adopt the technology; shortly thereafter, essentially all of the mainstream social networks do so, as well. Longtime identity activists grumble about Google stepping in and taking over, but the system proves sufficiently powerful and reliable that the activists start using it, too.

This development serves as a catalyst for a new model of Internet connection: subscribing to people. Usable identity technology enables friends and family to receive streams of digital information about a

given person, and allows the “sender” to tweak exactly what kinds of material goes where. The “interface-agnostic” concept really shines here, with identical life subscriptions appearing as anything from a simple list to a full-blown simulation, depending upon the software used to follow them.

2014: Language is a Virus

As the reputation network advocates slowly begin to rebuild their systems—using the identity management tools as a core—a new technology gives the reputation model a shock from an entirely unexpected direction.

Samsung releases software allowing for real-time, highly accurate (over 99%), context-sensitive language translation. Initially embedded in their phones, Samsung offers to license the code at extremely generous rates (sometimes even for free), in the name of promoting international harmony. The result isn’t quite what they expect; it turns out that what was needed along with language translation was some kind of cultural translation.

This hits the reputation network folks hard, because reputation is a highly culturally-situated concept. Behaviors that would be neutral or even commendable in some locations can be disdained or reprehensible in others. Revisions to the reputation algorithms help to smooth some of this out, but problems remain, globally.

At the other end of the size spectrum, cheap, safe micro- and nano-implants finally enable the kind of real-time personal health information that futurists had been talking about for more than a decade. These data streams promptly get added to hundreds of thousands of personal subscription systems.

2016: You Own Your Own You

It comes as no surprise that one of the big repercussions of the ubiquitous ocean of real-time personal data—now even down to the genetic level—is litigation over ownership. The worst abuse cases are easily decided, but the courts seem genuinely confused over the proper nature of control over the most personal information made visible by these technologies. Unfortunately, the Supreme Court punts the issue back to Congress.

2018: Digital Me

With reputation network technology finally working reasonably well, new industries spring up to monitor, cleanse and protect one's online karma. Perhaps most surprising is the proliferation of services to defend reputations by spreading *misinformation*, essentially spoofing the system by overwhelming the "signal" with "noise." False identities, imaginary documentation, wild (but just plausible) accusations... some of what these businesses would do borders on the illegal, but there are many people, mostly middle-aged, who hate how much about themselves can be so readily discovered.

At the same time, children born with full digital documentation of pregnancy and their first years are beginning to become teenagers. This is a generation that has lived its entire life with a rich, deep Internet shadow. Very little of what they've done, made, or (in some cases) said has disappeared; they have a very different vision of what privacy and openness mean. Even adults who had put their most embarrassing moments up on MySpace shudder at how much this generation is willing to reveal.

These teens become the most aggressive adopters of always-on, always-recording web tools, offering lifelogging taken to the ultimate degree. Confident that their identities will be secured, comfortable with the reputations they'd been developing since they were in pre-school, and ultimately unconcerned about the legal niceties of ownership, this generation is a harbinger of a coming decade that promises to be far more disturbing to the status quo than the 2010s could even have hoped to be.

In this scenario, the browser as a distinct software tool remains more or less present throughout. As with the other scenarios, the browser serves as an interface to a wide variety of content types, but in this case, many of those data are turned into web pages for easy browsing, rather than entirely distinct protocols. One major development is a much greater reliance upon real-time information streams, whether from one's own body, from dynamic reputation networks, or from the myriad sources of information flows about friends, family, and co-workers.



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