Of Boilers, Bit, and Bots

Grady Booch

ONCE UPON A TIME, boilers used to blow up quite often, killing many people. This was generally not seen as a good thing.

Despite the comforts that boilers brought to life—trains and steamships that could transport people and goods faster than a horse, central heating for buildings previously warmed by individual fireplaces, power for innumerable manufacturing industries from milling to weaving to machining—the social transformation and human cost couldn’t be neglected. In the second half of the 1800s, professional engineering organizations formed, best practices were codified into law, and the ethos of living with these noisy, smelly, and sometimes explosive boilers slowly entered the daily life of everyone dwelling in an industrialized city. It took much longer to regulate the pollution associated with coal-burning boilers, but that too mostly came back into balance (only to be subsumed by other kinds of energy-related pollution).

But, by going back in time, I get ahead of myself. Let’s begin again with three contemporary stories.

On Privacy, Regulation, and Encryption

There’s a site that lets you watch tens of thousands of unsecured Internet connected cameras (www.insecam.com). The public outrage over this site has been rather vociferous, especially by those who have found their home or office on the list. Their reaction is quite understandable. For the most part, we all have some expectation of privacy in our personal spaces, and we rightfully assume that what happens behind closed doors will remain hidden from public view.

On the other hand, the reaction by the technical community has been far less sympathetic. As many have noted, putting an unsecured IP camera on the Internet is akin to placing your home or office on a busy public street, installing large glass windows, and leaving the drapes open. Of course—as the digerati point out—you have abrogated your right to privacy by being so careless.

Amazon just announced the Echo, an intentionally unobtrusive physical artifact that embodies Alexa, an ever-present digital personal assistant. Alexa joins a growing family of personal digital assistants, including Apple’s Siri, Microsoft’s Cortana, and Google’s Now.

We aren’t by any means even close to a really personal digital assistant such as Samantha, as found in the universe of Spike Jonze’s Her, but it’s not hard to trace the trajectory of such technology. Human as we are, we often desire an uncomplicated and compliant companion to...
assist us with the tedium and cruft of life. Even today, the wealthy and the famous might have the means to hire a flesh-and-blood personal assistant; technologies such as Alexa, Siri, Cortana, and Now bring some of that ease to the masses.

That being said, there are certainly issues worth debating publically. As one observer wryly noted regarding Echo’s product features, the “NSA, CIA, and FBI would like to personally thank Amazon for installing spy mics in every home” (http://techcrunch.com/2014/11/06/amazon-echo/#comments). While I don’t exactly share that level of cynicism or paranoia, the observer does make a valid point: In a digital world, what’s the meaning of trust?

There are any number of legal battles going on whose front lines are at the confluence of the digital and the social. The FCC is at the center of the debate about network neutrality. Many ISPs are against it, driven by economic needs that prefer an unregulated Internet (just as long as the playing field still tilts unnoticeably in their direction), whereas many of those representing consumer rights are against it. FBI Director James Comey has come out against the efforts by Apple and Google to encrypt their phones in ways that increase consumer privacy at the expense of law enforcement having easy access to the data behind such encryption. Taylor Swift’s latest album 1989 went platinum—the first such album of 2014, in a year in which music sales were deeply reduced—in spite of explicitly withdrawing her tracks from the digital streaming service Spotify.

What can we make of these contemporary stories?

**Now and Then**

Let’s return to the age of boilers, the age of the great Industrial Revolution that transformed nations and lives. This was also the age of Charles Babbage and Charles Dickens (who, by the way, died only about a year apart). In his marvelous book *Charles Dickens in Cyber-space* (Oxford Univ. Press, 2006), Jay Clayton speaks of the societal transformation that took place in that era, a time that I also spoke of in my earlier column, “To Code or Not to Code” (*IEEE Software*, vol. 31, no. 5, 2014, pp. 9–11). Referring to Jane Austen’s novel *Mansfield Park*, Clayton observes that part of the plot hinges on “the consequence of complex interactions among varied communications media”—in short, the juxtaposition of the pen and paper against the telegraph. Clayton notes, “we live in an undisciplined culture again,” so our challenges in adapting to a digital culture are born out of the same human dynamics that people in the time of Babbage and Dickens faced in adapting to an industrialized culture.

Boilers used to blow up, but science and industry were compelled to mitigate the underlying causes, and society and the law eventually metabolized their use. Cameras, digital assistants, and encryption sometimes yield terrible results, yet the art and science of computing is similarly compelled to mitigate their negative aspects. Furthermore, we have a generation being born who doesn’t know that these things once didn’t exist.

Let’s return to each of my contemporary stories one last time.

**Evolving Doors**

The problem with unprotected cameras is just one visible manifestation of a much larger issue: the growth of the Internet of Things. Who in his or her right mind would have imagined a world in which doorknobs and light bulbs would have unique IP addresses, much less each of us carrying around mobile network device (our phones) and driving around in our cars (which themselves are networked)? Well, actually, a few prescient folks did predict such a thing, but the basic undercarriage of the original Internet was never crafted for such circumstances (thus the recent move from the IPV4 address to IPV6).

In the early days of the Industrial Revolution, who would have thought of putting a boiler in every home? Well, we do now, in the form of water heaters. These things are still capable of explosion and damage, but we’ve largely engineered the risk out of them. Also, their user interface is so simple that we mostly don’t even think about them, they have so faded so completely out of sight.

So it will be with these cameras and other connected devices, but with one big difference. By their nature, they’re connected in ways beyond our choice—their meaning is materially different from the water heaters we place in our homes. How then do we cope? The general public must adjust; they must accept the additional risk that these things might blow up in unintended digital ways.

At the same time, we who develop, deploy, and deliver such technology must engineer the risk out of them and make them so simple we don’t even think about them. As we engineers know, making things simple is terribly hard, but the human use of our software-intensive artifacts demands it.

The rise of cognitive assistants brings us to exactly the same perspective. Whereas the Internet of Things connects us to one another, Siri, Cor-
tana, Now, and Alexa have the potential to give us something much more intimate: ways to connect to ourselves, to reduce the friction of life. We engineers still must drive the risk out of these artifacts and make them part of the atmosphere. This too is very hard, made even more so because we’re talking about software-intensive systems that can become extremely personal. Not only do we need good software engineers and cognitive scientists building such things, we also need psychologists, cultural anthropologists, and artists to be a part of the journey.

As for the vibrant legal morass that we now see at the intersection of computing and humanity, let me offer the positive spin on it that the presence of such noise might actually be a good thing. Science and technology always precede the rule of law. The fact that we see public debate suggests that the time has finally come for society to codify best practices into law, just as in the age of boilers. The thing we nonlawyer software types must get used to is that the business of making laws is incredibly messy, often muddled and inconsistent, and rarely ever stable or settled. To that end, as computer scientists we must both accept the rule of law and not be silent in its making.

The story is often told of Steve Job’s maniacal focus to shave milliseconds from seemingly trivial parts of the Mac OS. Under his point of view, even milliseconds—when multiplied by trillions of times of execution—add up to human cost. Early boilers were incredibly sloppy and wasteful, but we engineered efficiencies into them. Most of our Web-centric systems are equally sloppy and wasteful, but because we live in an abundance of computational resources, the energy costs of a simple RESTful interaction are often ignored. And yet, when multiplied by trillions of times of execution, they do add up to cycles spent on a server, electricity consumed, and some fuel—fossil, hydroelectric, nuclear, or solar—expended.

We, who have the privilege to develop, deploy, and deliver software-intensive systems that matter, shouldn’t expect the general public to grok the intimate technology with which we live and breathe and in which we delight. We must design these artifacts as if our children’s lives depended on them (and, in many cases, they do). We’re the builders of these modern-day digital boilers that entertain us, feed us, care for us, and serve us. It’s our responsibility to ensure that we do our work with the utmost professionalism and care for the human spirit, to which our work is ultimately directed.

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