The Elephants in the (Server) Room:

Sustainability and Surveillance in the era of Big Data.

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All Watched Over by Machines of Loving Grace

I like to think (and
the sooner the better!)
of a cybernetic meadow
where mammals and computers
live together in mutually
programming harmony
like pure water
touching clear sky.

I like to think
(right now please!)
of a cybernetic forest
filled with pines and electronics
where deer stroll peacefully
past computers
as if they were flowers
with spinning blossoms.

I like to think
(it has to be!)
of a cybernetic ecology
where we are free of our labors
and joined back to nature,
returned to our mammal
brothers and sisters,

and all watched over by machines of loving grace. [1]

Introduction

Brautigan's poem might be the root document of the San Francisco hippy techno-utopian movement which spawned the Whole Earth Catalog and Apple Computer, which Theodor Rosak described in his essay From Satori to Silicon Valley, (Roszak) and which was later dubbed 'California Ideology' by Richard Barbrook and Andy Cameron. But what Brautigan et al probably could not conceive of was the wholesale reconfiguration of society and economy which would necessarily attend the infiltration of computing into diverse aspects of life. Typical of that context - the era of the 'giant brains' - is his portrayal of computers as coexisting but separate.

There are, as I have noted previously (Penny 2012) and as others have concurred (Ekman this volume) various conceptions of 'ubicomp' (ubiquitous computing) which seem different enough to make the umbrella term of dubious usefulness. These include what we call Social Media, the Internet of Things and Mobile Computing. Discourse around ubiquity (in the HCI community) has (understandably) tended to focus on immediate human experience with devices. The faceless aspect of ubiquity, the world of embedded microcontrollers, sometimes referred to as 'the internet of things' has largely evaded scrutiny in popular media and press, precisely because of its invisibility (though it has attracted the attention critical media-art interventionists for over two decades).[2]

The seemingly inexorable trend to ubiquity, we were told, would result in a calm technology that recedes from awareness, and abides in the background, seamlessly lubricating our interactions with the troublesome physical world, or at least the contemporary techno-social context (Weiser). And this, somehow, would be better than the giant brains of the 60s, the corporate mainframes of the 70s, the PCs that chained us to the desk in the 80s, or the internet of the 90s. But as John Thackara has noted:

'*Trillions of smart tags, sensors, smart materials, connected appliances, wearable computing, and body implants are now being unleashed upon the world all at once. It is by no means clear to what question they are an answer – or who is going to look after them, and how'*. (Thackara 2006, 198)

Pragmatic as Thackara is, his observation prompts us to reflect upon ideas of 'progress', and the covert presence of a Victorian techno-utopianism in technological agendas, including ubicomp. A pithy summation of this syndrome is found in "An Interview with Satan" in which Satan explains:

Technology is all about painstaking simplification, driven often by a desire for order and predictability, which produces complex - and unpredictable - effects. It's a kind of mania for short-cuts which leads to enormous and irreversible detours. Now this is my business in a nutshell ... Imagine a world where every desire can be instantly frustrated, indeed where every desire can be guaranteed to arise precisely customised to the means for its dissatisfaction, where every expectation will be immediately, and yet

unexpectedly thwarted … Technology cannot fail to bring about this world, since this would be a universe brought fully under control, consistent with the very nature of technology. (Dexter 1996)

The entirety of the phenomenon we call ubicomp is underpinned by network infrastructure, server farms and Big Data. Like the cinema and the automobile, computing and digital communication has created entirely new industries and professional contexts. In the case of the automobile, the most obvious novelty was the emergence of automobile mass production itself. Further thought brings to mind the manufacturers of special parts – brake parts, engine parts, and the like. But beyond this horizon the automobile economy ramifies in all directions – mineral extraction and materials production, the oil industry, the rubber industry. The modern automobile has evolved symbiotically with the development of civil engineering and roadmaking and this in turn has had a huge effect on the shapes of our cities and towns. In the case of the cinema, the convergence in the second half of the 19th century, of several emerging technologies – photography, precision machining, chemical engineering, mass-produced optics, and electricity - to name the most obvious – led to the emergence of entirely new socio-economic phemomena, the most obvious being film studios and production facilities, with new career paths from cinematographer to producer to stuntman to 'special effects'. So it is with ubiquitous computing and it's complement, the internet.

It is in the spirit of such holistic overviews that I here address ubiquitous computing and related matters. My goal in this paper is to draw attention to a range of 'big picture'

issues pertaining to infrastructure, energy and resource use and socio-economic integration - centering on questions of sustainability and civil rights, touching upon some theoretical and historical issues where relevant.

Computing as Natural

"…computers, as if they were flowers…"

The notion that computing is both natural and neutral no doubt serves the interests of those whose interests will be served by selling more digital appliances. We are increasingly naturalized to computing as a part of our environments and lifestyles. But ubiquitous computing did not just grow like a tree, integrated into the environment it was a product of. This is not to endorse some naïve notion of the natural, but to draw attention to the highly culturally specific and historically contingent nature of digital computing, as a class of computing, different from others (analog connectionist, and evolutionary computing), with no greater claim to legitimacy. Digital computing, as Jay Bolter argued long ago (Bolter 1984), is our paradigmatic technology – it is the technology which provides us with metaphors. In a decade or two, such ideas will seem as naïve as the 'mechanism' of a previous epoch - that the universe and physiology could all be explained in terms of clockwork – gears and springs.

Babbage and Turing notwithstanding, Claude Shannon's deployment of George Boole's binary algebraic logic in analyzing electromechanical telephone switching networks is an originary moment in digital culture, because, in the process, he saw that electromagnetic

relays could perform Boolean logical operations. Boole's work was classical Victorian scholarship, his major work being 'Laws of Thought' (which, it is said, he pursued as a result of a mystical experience).

This is to say - there is nothing 'god-given' which confirms that pixels, voxels, digital arithmetic, logic gates or Boolean algebra are either natural correlates to physical reality, or optimal augmentations for the things people like, want or need to do. The instrumenting of the world and the establishment of a global system of real time communication and record keeping is undeniably real. But just as undeniably, it is an historically contingent human cultural effect.

We are of course naturalised to such ideas. Cognitivism tells us that the brain is a computer, AI tells us that thinking is symbol manipulation. Modern genetics is full of the computer code analogy for DNA. Every year or so, there is a new claim that the universe is a giant Virtual Reality simulation. During the Virtual Reality era of the nineties, Ed Fredkin amused crowds with 'twilight zone' stories that the universe was VR, or that the universe is a computer simulation, and as a result so are we, though we would be unable to know this. This was also the basic idea behind Rainer Werner Fassbinder's two-part WDR telemovie *World on a Wire*.[3]

Fungal Technology

The mobile devices we use and are preoccupied with are the gritty salty detritus where the digital ocean laps against the shore of human temporality. The mobile phone in your

hand (or the microcontroller in your car) is nothing but the materially immediate bud of a new global quasi-organism interconnected by a quasi-nervous system with optical, electronic and radio-frequency dimensions and vast organs hidden from view.

We used to think of mushrooms the way we think of plants – as largely aerial manifestations with roots. Now we understand that fungi are vast underground organisms and the mushrooms are nothing but reproductive buds – manifestations of a Borg-like superorganism proliferating threadwise beneath our feet. In the Malheur National Forest in the Blue Mountains of Eastern Oregon, U.S., a colony of *Armillaria ostoyae* encompasses 10 km² (around 1000 acres). At this point it is regarded as the largest living organism in the world and is estimated to be at least 2400 years old, possibly nearly 9000.[4]

Critical theorists have rejoiced for a generation regarding the rhizomatic nature of the internet topology. I cast the internet /ubicomp scenario in this light merely to draw attention to the novel technosocial and geopolitical situation which has emerged in little more than 20 years. This fungal technology has grown rapidly, and while the scale of information transmission is well known, the contemporary landscape of resource use is as unprecedented as it is obscure. As the vast and ancient *Armillaria Ostoyae* of Oregon has exterminated acres of forest, so the ubicomp/social media/internet complex has reconfigured the socio-economic ecosystem, leading to rapid growth in new profit centers (Amazon, Facebook, Google), and the collapse of long-established business models like department stores, newspapers, the post office. This is not, of course, to endorse a

simplistic technological determinism. Such changes are socio-economic systems, involving desire, wealth and politics in complex feedback loops. There are ways in which contemporary ubicomp – like any new technology - feels novel and unprecedented. But it has grown out of and upon existing systems constructed largely by human actors immersed in and formed by cultural contexts. It is not my intention to imply some distopic sci-fi scenario but to explore and consider the implications, social and environmental, of this new symbiotic ecology of humans and representational machines.

We might well ask is 'is this phenomenon historically unique?' Has a substantial portion of the labor of humanity been so rapidly and embracingly marshalled around a technological complex in similar ways before? Printing and railway come to mind. Perhaps, more abstractly, precision mechanisms, from the clock to the lace making machine. As a techno-social revolution this would seem comparable, though it occurred over a substantially longer time period, see (Mayr 1989). Or one may take Beniger's argument that the 'information revolution' is just the most recent stage in the control revolution (Beniger 1989).

Symbiosis - Humans as sensor and effector peripherals

Still, twenty-five years after the demise of Good Old Fashioned AI (Haugeland) one still hears excited conversation regarding the purported 'singularity' (Kurzweil) when computational 'intelligence' exceeds human intelligence. Ergo, a generation after Dreyfus's phenomenological exegesis (in 'What computers can't do') the conception of intelligence which make such a proposal even possible is thoroughly dependent on the

idea that the requirements for thinking, or intelligent action in the world, are satisfied by the Physical Symbol System Hypothesis. In relation to the present discussion, it is important to recognize that however powerful localized or distributed digital computer systems are, they can only make meaningful interventions in the world by virtue of human interpretation of the world, and the accumulated history of such interpretation.

According to the Sense Map Plan Act paradigm of conventional AI, robots operate in the world via a serial von-Neumann process of input, processing and output. This linear metaphor is based on the mechanistic models such as the industrial production line rather than biological, ecological or enactive models. Internally, according to this model, perception is separate from action, separated by information processing, in a linear one-way process. The sensor and effector ends of the process are referred to, significantly, as 'peripherals' and serve the function of transduction into and out of digital representations. This conception reproduces an enlightenment individual autonomy, and eschews consideration of community, intersubjectivity, agency, feedback, adaptation, autopoiesis, or enactive conceptions of cognition.

The failure of GOFAI was rooted in the insurmountable difficulties in coordination of information systems with the real, lived physical world 'out there'. In hindsight, it should not have been a surprise that an automation of Victorian mathematical logic was neither necessary nor sufficient to equip a synthetic organism to cope in the world, but such was the hubris of the field. In this history we see AI cast not so much as a futuristic but as anachronistic.

In an ironic twist, the techniques developed in AI for sophisticated data analysis, such as machine learning, data mining and (so called) knowledge engineering, have found a second life (as it were) on the internet. The key to this success is that in the dataworld, the difficult translation of the real, lived physical world 'out there' has already been done, mostly by humans who are unaware that they have been contributing to the construction of databases by tagging photos, entering text and generally providing metadata for the world.

Automating the interface with the world of electro-physical phenomena is one of the key characteristics of ubicomp, in its 'embedded' manifestation. Seismic sensor nets autonomously collect the relatively simple data regarding the time and strength of geological vibrations (by converting them into voltages and then into numbers). But significantly, the realm of social and cultural understandings remains complex and locally specific and continues to evade automation. As with the SAGE system of the cold war, humans (still) do the work of subtle pattern recognition and processing of real world experiences into data for the machine learning algorithms to churn. [5] Every face identified in a photo, every place named on Google earth, every vacation photo uploaded, every character string decoded in reCAPTCHA, every Facebook 'like', enriches the databases. Crowdsourcing and social media mine human sensing. In a truly sci-fi scenario, we have become the symbiotic skin of the internet, the membrane which converts the tangible to the virtual, the analog to the digital. The latter decades of the twentieth century were haunted by the spectre of sentient machines. That spectre has

waned along with the fate of Artificial Intelligence (see below). With the growth of the internet, worldwide web and wireless communications, a different spectre haunts ubiquity. The emergence of a globally linked 'datasphere' accessible to both machine and human agents (as presaged in sci-fi and media theory over the last three decades) is the phenomenon we might call Artificial Awareness. [6]

INFRASTRUCTURE

The Cloud – ubicomp's virtual reality

The terminology of the 'cloud' encourages is to imagine dematerialised information floating around in an immaterial instantly accessible but placeless nowhere.
The 'cloud' is this decade's version of 'the virtual'. While the metaphor of the 'cloud' is poetic, 'cloud computing' neatly obscures the gross material reality of today's communications infrastructure in the same way that 'free' online services obscure the for-profit nature of the business.

Datacenters, or more colloquially, 'server farms', now occupy huge tracts of land and consume vast amounts of power. In the city of London, more greenhouse gasses are generated due by computing, (computers, servers, power consumption and supporting infrastructure) than by all surface transport (trains, underground, cars, buses, taxis etc). Similarly it is said that the world's server farms consume more power than all civil aviation. As James Glanz noted in an article of mid 2012, "*Worldwide, the digital warehouses use about 30 billion watts of electricity, roughly equivalent to the output of 30 nuclear power plants … Data centers in the United States account for one-quarter to*

one-third of that load…." [7] A significant proportion of the data transported over the internet and stored in those server farms is junk – spam, records of clicktrails and other automatically recorded metadata, or duplicated and outdated records. Glanz continued – "*Stupendous amounts of data are set in motion each day as, with an innocuous click or tap, people download movies on iTunes, check credit card balances through Visa's Web site, send Yahoo e-mail with files attached, buy products on Amazon, post on Twitter or read newspapers online..."* [8]

The Cloud is full of metal

The ubicomp/big data system consumes material resources and energy, and produces waste, at a prodigious rate. Substantial parts of national and local energy budgets are consumed by the information economy. Vast tonnages of copper and other metals hold it together, and the increasingly important global 'rare earth' market is driven by the needs of digital technologies.[9] The constant updating of digital appliances is creating unprecedented pollution crises in countries least capable of dealing with the repercussions. This new socio-economic order consumes the labor of millions all over the world, from the computer science professor at Stanford to the programmer at Google to the cable guy who hooks up your modem, the salesperson at the Apple shop, the assembly workers in Shenzen and in the maquiladoras or northern Mexico, and the customer service representative in Bangladesh.[10]

Server farms – the internet's landfill, full of data trash

The notion that the internet is clean and 'green' is as bankrupt as the idea that computers would usher in the era of the paperless office. The environmental website planetsave.com summarises: "*If the Internet were a country, it would rank fifth in the world for amount of energy consumption and carbon dioxide emission. According to Greenpeace, the Internet consumes more power than Russia. … A large percentage of the data centers that house computer servers rely on non-renewable energy sources to power their cloud computing. In fact, according to Greenpeace, at least 10 major tech companies (which include Apple, Amazon, Facebook, and Twitter) depend on nuclear and coal-powered energy rather than renewable forms of energy such as solar and wind. Greenpeace estimates that, when functioning at full capacity, Google's eight server farms could use up to 476 megawatts of electricity, enough energy to power all of San Diego*." [11] Server farms continue to expand to support the illusory 'cloud'. "Microsoft recently purchased 200 acres of industrial property from the Port of Quincy for $11 million. [12] "*This new development will be the largest server farm in Quincy; the site is more than three times the size of the current property Microsoft owns there, which is the size of 10 football fields. The company is clearly building out its infrastructure in support of its cloud computing initiatives*." [13] How much data (don't call it 'information') is stored? In an NPR radio interview, a worker at a vast server in Nevada observed that the racks of servers they were looking at – standing on an area roughly 3m x 4m, the size of an average bedroom, could hold all the writing produced in the entire history of the human race. Meantime the rows of server racks disappeared in all directions into the hazy distance – full of digital trivia generated in the last two decades.

Nor are these sprawling data giants exclusively the territory of computing and communications corporations. Unsurprisingly perhaps, the US NSA is a very active participant in big data collection and storage. *The Utah Data Center, also known as the Intelligence Community Comprehensive National Cybersecurity Initiative Data Center, is a data storage facility for the United States Intelligence Community that is designed to store extremely large amounts of data… Its purpose is to support the Comprehensive National Cybersecurity Initiative (CNCI)… The megaproject was completed in late-2013 at a cost of US$1.5 billion despite ongoing controversy over the NSA's involvement in the practice of mass surveillance in the United States*. [14]

The page goes on to report " *One report suggested that it will cost another $2 billion for hardware, software, and maintenance. The completed facility is expected to require 65 megawatts, costing about $40 million per year. The facility is expected to use 1.7 million gallons (6500 tons) of water per day*."

THE FRIENDLY FACE OF SURVEILLANCE

Who pays for Facebook?

I asked my students 'who pays for Facebook?' Many of them looked at me quizzically, saying 'its free'. So I then asked them to reconcile that with the fact that Facebook is a multibillion dollar business, equivalent to Intel and Home Depot. Home Depot sells stuff. Intel sells a different kind of stuff. How can Facebook have expected revenue of around $8 billion this year? What does it sell, and to whom? Doubtless most of the readers of this essay will have a clearer understanding of the emerging phenomenon of Big Data

Capitalism than my students, and of the ways that social media enterprises, ISPs and phone companies store, analyse and aggregate user data, and merchandise it.

Fifty years ago, it came as a surprise when it was revealed that department stores and similar businesses were no longer primarily in the business of selling goods but of market speculation. Storefront operations and product sales simply provided a revenue stream for investment. In social media, business is done in a wildly abstract way. Users partake of 'free' services while (usually unknowingly) providing raw data to corporations in exchange. User Data is harvested and processed, packaged and sold. That data includes names, ages, genders, hometown locations, languages, social connections (*e.g.*, likes, friends or followers), screen names, web site addresses, IP addresses, interests, and professional history. Further intelligence is culled from tweets, posts, comments, likes, shares, uploads, downloads and recommendations collected from Twitter, Facebook, LinkedIn, Blogspot, Wordpress, Myspace, Youtube and other social media sites.

A recent post entitled "Big Data + Big Pharma = Big Money" reports on an obscure big data niche – "prescription drug information intermediaries". One of the players in this field, IMS Health Holdings Inc. of Danbury, Conn., earned nearly $2 billion in the first nine months of 2013. IMS says its collection includes "*over 85 percent of the world's prescriptions by sales revenue*," as well as comprehensive, anonymous medical records for 400 million patients, amounting to 45 billion health care transactions each year - 10 petabytes worth of material — or about 10 million gigabytes, a figure roughly equal to all of the websites and online books, movies, music and TV shows that have been stored by

the nonprofit Internet Archive. *"All of the top 100 global pharmaceutical and biotechnology companies are clients*" of its products, the firm's prospectus says. [15] This is the landscape of data business – vast and highly profitable, but invisible – no goods, no warehouses, no advertising.

Recently, it was revealed that Facebook had 'outed' gay people via a combination of facial recognition and inference-based ad selection. In a recent post titled 'Is Facebook outing gay users to advertisers", Adrian Chen notes *"...this latest snafu underscores how nearly impossible it is for Facebook to both profit from your personal information and to guarantee it will never be shared without your permission..."* [16] This is on the heels of a minor scandal where the Target retail chain, based on data analysis, was able to target women who were likely to be pregnant with special advertising. At least one family learned of their daughter's pregnancy this way. [17] Examples such as these reveal the complex legal and civil rights implications of this new and ambiguous territory which is both free and charged, both public and private, both virtual and with real world effects. The emergence of social media has opened quasi-public virtual communications spaces, which have some of the qualities of good old fashioned public space (if such a thing ever existed) but offer wildly enhanced (telematic) capabilities, while at the same being private, controlled, actively surveilled and generative of substantial profit.

On a personal and social level, ubiquity is forcing a reconfiguration of notions of privacy and of public space. Notions of self and of sociality underpin ideas of public and private. Hence the reconfiguration of these concepts implies both cognitive and cultural change.

In order to better comprehend the transformation of 'the private' and 'the public', we must consider them together, and through the lens of ubiquity, which is the major vehicle via which these changes are occurring.

"Facebook 'likes' become customized Walmart ads"

Users pay phone companies and ISPs for service, but provide another revenue source which is skimmed off. In the US, Verizon holds user data for 12 months, Sprint 24 months, Tmobile for 60 months and AT&T for 84 months. Thus most users will have over a million pieces of information stored about them spanning over 40 months. [18] This kind of information is of course what fills the server farms, where it is constantly churned, remixed, analysed and sorted by sophisticated algorithms. Michael Rigley notes "*Facebook likes become customized Walmart ads*".[19]

Back in 1973, Richard Serra and Carlotta Fay Schoolman produced a short video called Television Delivers People, which noted "*in commercial broadcasting the viewer pays for the privilege of having himself sold…It is the consumer who is consumed…You are delivered to the advertiser who is the customer*." [20] The video notes that for every dollar spent by the broadcasting industry to deliver content (in 1973), the viewer paid $40 to receive it. The calculus in the internet industry must be similar – consumers pay for hardware, software, connectivity and subscriptions to online services in order to take advantage of free services. *Plus ca change…*

Two decades ago, the fall of the Berlin wall was lauded in the west as the victory of democracy and free speech over state surveillance and repression, typified by the vilified Stasi of East Germany. Two decades after the collapse of the Soviet Union, Americans and others now partake in a system of surveillance arguably quite as invasive and far more efficient. Part of this system is called social media, and there is no small irony in the fact that we not only willingly partake in it but *pay* to do so.

Activist politics of Big Data

Activists like the Electronic Frontier Foundation have mobilized around issues over several decades around the sociopolitical realities of big data, surveillance and the 'digital commons', combined with an awareness of the waning of the concept of 'public space' remind us that the landscape of the social has changes radically in the last 25 years, epitomized by the 'always online' status of an increasing proportion of the population. The philosophical, political and legal dimensions of this new condition continue to be debated. Meantime corporate and state entities have colonised the new territory as if it was a legal *tabula rasa* and commercial data aggregation by operations such as Acxiom, Experian, Epsilon and Choicepoint are just entering public awareness. [21] It is notable that interventionist artists and groups flagged these issues over two decades ago (Schultz 1993). During the 90s, concerns tended to be grouped under the rubric of 'surveillance' as in the work of Julia Scher, the Institute for Applied Autonomy, Trevor Paglen, Critical Art Ensemble and others.

Databody

In 2003, media artists Brooke Singer, Beatriz Da Costa and Jamison Schulte presented Swipe, a media intervention staged as a bar, where patrons were required to pay for drinks with a card and have their drivers licenses swiped. The (usually surprised) customer received a cash register receipt often 2-3 ft long which included a printout of the data stored on the divers license and in databases instantly accessible by that license swipe. This data included previous addresses, automobile and legal records. The exhibition blurb states "*Swipe addressed the gathering of data from drivers' licenses, a form of data-collection that businesses are practicing in the United States. Bars and convenience stores were the first to utilize license scanners in the name of age and ID verification. These businesses, however, admit they reap huge benefits from this practice beyond catching underage drinkers and smokers with fake IDs. With one swipe—that often occurs without notification or consent by the cardholder—a business acquires data that can be used to build a valuable consumer database free of charge. Post 9/11, other businesses, like hospitals and airports, are installing license readers in the name of security. And still other businesses are joining the rush to scan realizing the information contained on drivers' licenses is a potential gold mine. Detailed database records, of course, also benefit law enforcement officers who can now demand this information without judicial review in large part due to the USA Patriot Act*." [22]

The accumulation of the *databody* - the digital representation of a person stored in databanks - has been a critical issue since the early 90s, and came to a head politically with the scandal around the Total Information Awareness (TIA) program of the US Information Awareness Office, which was briefly operational - from February until May

2003 - before being renamed the Terrorism Information Awareness Program. In early 2013, at a private gathering in London, Google Exec Larry Page stated "*anything you put in the cloud is there forever*" [23] All the information we innocently put into the system is being watched, harvested, aggregated and put to purposes we not only didn't authorize but mostly couldn't imagine.

Ubicomp for and against the State

The advent of global ubiquity offers new repressive apparatus to the Nation State, and simultaneously challenges the coherence of the Nation State – a reality acknowledged by some states which control internet communications. Nor is a clean separation between state and corporate operations possible. Consistent with the contemporary ethos of government subcontracting - with the likes of Haliburton and Blackwater - US government agencies buy data and services from the likes of Acxiom and Epsilon. State surveillance is clearly not going away, as indicated by the ongoing revelations arising from the Wikileaks and Snowdon affairs. New revelations about such surveillance seem to occur every week. In October 2013 we have leaned of the monitoring of the cell phones of German Chancellor Angela Merkel, Brazilian president Dilma Rousseff, French and Mexican politicians, and scores of others, seemingly for a decade or more.

In December 2013, new releases from the Snowdon files showed that in 2008, the NSA (and UK equivalent GCHQ) had been monitoring MMORPGs such as World of Warcraft, Second Life and Xbox Live. While there was no evidence of useful information being collected, it seems that so many operatives were deployed on those sites that there were calls from inside NSA for a "group" to prevent the agency's personnel from

inadvertently spying on each other. This is reminiscent of reports of CIA and FBI infiltration of anti Vietnam war activist groups in the 70s. It was said that many such groups contained more state agents than actual activists.

In a not too surprising twist, it transpires that the CTO for San Francisco-based Linden Labs, Cory Ondrejka "*was a former Navy officer who had worked at the NSA with a top-secret security clearance*" [24]. In March 2014, it was revealed that the NSA had created false Facebook servers and had collected data on Facebook users. Founder Mark Zuckerberg was so disturbed by this he called President Obama and later wrote in a blog post: "*I've been so confused and frustrated by the repeated reports of the behavior of the US government. When our engineers work tirelessly to improve security, we imagine we're protecting you against criminals, not our own government*." Curiously, the aforementioned Ondrejka was hired by Facebook in November 2010 and is now the director of mobile engineering. [25]

In the early 1990s, when computer graphics and VR was all the rage, I was surprised, then not so surprised, to see that technical operatives moved between military work and entertainment industry work seamlessly, especially as the entertainment industry became interested in 3D simulation and the military became interested in shooter games as training simulators. (Penny, 2004) This observation led me to coin the phrase 'military entertainment complex'. In the same way, it is surprising, then not surprising that themes of cybersecurity, cyberwarfare and cyberterrorism should be equally interesting to the NSA and to billion dollar corporations like Facebook.

Cyberwarfare has been a priority of the pentagon for years and no wonder. With appropriate hacks, control of power or communications infrastructures can bring a state to its knees without so much as a shot being fired. The capture of a CIA RQ-170 sentinel unmanned spy plane by Iran in December 2011 must have been deeply embarrassing. According to reports, it was captured by jamming satellite and land-based communications to the plane then issuing false GPS data to it. As a result the plane landed itself safely in Iran, thinking it was 'home'.

No doubt, if I was a technologically aware terrorist, gangster or other ne-er-do-well, I would consider the use of these sophisticated quasi-anonymous social media systems for covert communications. Hakim Bey's formulation of the TAZ (Temporary Autonomous Zone) (Bey 1991) has had and will continue to have, particular relevance in the rapidly changing technological landscape. And likewise, if I were a security operative, safeguarding communications for a state or a corporation, I would be thinking very carefully about the security of the systems I was responsible for.

Algorithms take command

The application of algorithmic automation across diverse aspects of human activity is one of the hallmarks of ubicomp. Most of these applications are relatively trivial or benign – the tracking of RFID tagged goods, or the monitoring of oxygen levels in your car engine. But inevitably, when the stakes for wealth or power are high, control is taken 'by whatever means necessary'. So it is in the arcane world of algorithmic trading, also known as Black box trading, which happens at such speeds that human oversight is not

possible. In the May 6th "Flash Crash" of 2010 the US stock market lost 10% of its value in 5 minutes due to the activity of so called High Frequency Trading Algorithms (HFTs). The effect was so alarming and so complex that it took the staffs of the CFTC and SEC months to piece together a rough picture of what had happened, which included so called 'hot-potato' trading, where algorithms were selling and buying stocks to each other at high speed for miniscule profits.[26] As one might expect, an algorithmic arms race has emerged, with algorithms designed to detect and thwart, or profit from, the actions of other algorithms. Today, 70% of stock trading is algorithmic trading, and trades take place in around 70 microseconds. To put the speed of these systems into perspective: an HFT can process more data in the time it takes for a human to click a mouse once than a human might read in their entire life. [27]

One of the more insidious effects of this algorithmic trading is that algorithms can act rapidly on financial announcements, reaping profits from changing values for investors while taking potential profits from slower moving actors, such a mutual funds. Such trading is known as 'shadow trading', as it occurs far faster than the monitoring technology of stock markets can track. The NYSE has the capability to monitor trades only to 10 milliseconds (1/100th of a second). [28] HFT's are performing operations in tens of microseconds, so an HFT might sneak in hundreds of trades before the watchdogs notice.

In the era of Big Data, useful information is generated less by sophisticated algorithms working on limited data than by relatively simple statistical processes working on almost

unlimited data. Contemporary algorithmically derived knowledge and power is not so much about cleverness as about sheer speed and brute volume. People not only do not know but cannot know the decisions which are being made by such algorithms which directly and significantly effect the stock market, and thus play a substantial role in shaping our lives. As with the Flash Crash, the system is out of human control. By the time a human clicks a mouse, (let alone the time it takes to realize something is going on) a billion more trades have occurred, which might have stabilized or further destabilized the situation. Any human reaction is already too late.

Some conclusions

In the United States, at least in the popular view, the assumption of an uncomplicated identification between democratic freedom and 'free enterprise' is axiomatic to political-economic discourse. In the academic ubicomp community there seems to be a similar lacuna in the assumption that such 'infrastructure' is politically neutral. How can it be neutral if it is designed by vested interests who put it in place for the specific goal of accumulating wealth and reinforcing their power? There seems to be an enduring underlying confusion between what developers and academics of liberal politics and general goodwill would like to see, or imagine as possible, and the stark reality of the technology as deployed, its purposes and results.

Ubiquity was built, and it was built by people with an interest, usually a financial interest. Ubiquity exists, largely because it makes money, or otherwise serves the interests of power. And in the process, it is something parasitic in the sense that it continues to suck

energy and resources. Yes, there are the oft trotted-out poster children: smart green buildings, instrumented bridges and sensor networks for seismic monitoring. But for every smart building there are ten autonomous weaponised drones, a hundred social media sites turning personal information into marketable data, a thousand miles of surveilled border, ten thousand RFID equipped commodities and a hundred thousand online purchases.

Unlike many of my ubicomp researcher colleagues, I have the luxury that I am not beholden to corporate grants or institutions which are otherwise 'in bed with' industry, so I am able to be explicit about issues on which they might be inclined to be reticent. Much research into aspects of ubicomp seems to proceed on the basis that these technologies are presumed to be ethically and politically neutral if not generally for the good. There is a taste of a rather irksome faux techno-utopianism in this.

Haven't we read enough techno-industrial history to learn that while visionaries and inventors are often motivated by a (sometimes foolishly deluded) belief in the redemptive potential of this or that technology, that such technological utopianism is shortlived, and these technological utopians are lauded only until the new technology turns a profit, at which point its 'business as usual'? It was this way for the locomotive, for the telegraph, for radio, and for the internet. We've had a quarter century of liberatory technoutopian rhetoric from consumer digital technology corporations. Personally, I'm tired of being liberated by technology. It's too expensive and its too much hard work.

In the same way that the term ‘ubiquitous computing’ embraces several quite separate socio-technological phenomena, there are also diverging ontologies of ubiquity. According to one, data is a kind of glue that joins things and makes them work better. On the other hand is the panopticism of ‘total information awareness’ in which people, individually and collectively, are managed, if not exploited, by data collecting and analysis – data-mining and knowledge engineering: all the things AI has become. Thirdly we are presented with the ‘HAL scenario’, in which our fates in the hands of uncontrollable algorithms.

I do not advocate a luddite or apocalyptic position, nor am I suggesting that digital communications corporations are by definition demonic, but it does seem that the field has tended to turn a blind eye to the fact that ubicomp would not exist if it were not enormously profitable and the motivation to continue to maker such profits is a prime driver of technological development. In this it is, like all human culture, historically contingent. If ubicomp had developed in the Roman Empire, or the Vatican in the 17th century, or the Soviet state, it would be a qualitatively different phenomenon.

Ubicomp may be desirable or advantageous or alienating or exploitative or all at the same time, but it exists and grows because it serves those who have the wherewithal to put it in place and so are poised to profit from it. Of course, such profits could not be made unless the products did not conform to the desires of the market, albeit desires themselves largely formed by marketing (Television delivers you). How should we assess the ‘free labor’ of millions who contribute, moderating fora, tagging photos or contributing to

open source code projects? (Terranova). Is that 'data' fairly available to all, or is data-capital skimmed off? How do we distinguish, in a principled way, between data systems which are wholesomely integrated into larger socio-political systems, and those which are unethically parasitic upon them, or deployed for surveillance and control? Just as we've become acclimatised to the 'information economy', the political economy of 'big data' demands further accommodation. We can address emerging social problems as problems in the social domain, but as always, civil rights, legal adaptation and governmental regulation play catch-up with changing technological contexts.

Simon Penny, Los Angeles, March 2014.

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[1] Richard Brautigan, San Francisco, 1967.
[2] See for instance, http://eyebeam.org/zapped-rfid-workbook. accessed December 27, 2013
[3] 1973, based on Daniel F. Galouye's 1964 American novel simulacron-3.
[4] http://www.scientificamerican.com/article.cfm?id=strange-but-true-largest-organism-is-fungus accessed December 27, 2013
[5] The SAGE or Semi Automatic Ground Environment was a cold war US ur-project linking radar installations along the east coast of North America in the first large scale real-time network. Many key ideas developed for SAGE have had lasting impact on the development of computing and digital communications, such as time-sharing and the screen-keyboard-pointer interface.
[6] My neologism.

[7] http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html?_r=0 accessed December 28, 2013
[8] *Ibid*.
[9] Some of the rare earth metals (Lathanides) and other obscure metals such as Germanium, Iridium, Platinum, Tantalum, are highly valuable and critical in electronics components, and present is very small quantities. Indium is used in touch screens. Nickel Metal Hydride batteries contain Lanthanum. Optical fiber contains Erbium. Tellurium is critical in solar cells (photovoltaics). Europium and Terbium are used in compact fluorescent lamps. China supplies around 95% of the world market for most of these metals. Wiring is generally copper, hardware is often cadmium plated. Printed circuit boards contain high amounts of precious metals; about 20wt% copper, 0.04 wt% gold, 0.15 wt% silver, and 0.01 wt% palladium. (ref - Recovery of Gold, Silver, Palladium, and Copper from Waste Printed Circuit Boards. Chehade, Ameer, Hisham, Naveena, Saeed and Taleb. *International Conference on Chemical, Civil and Environment engineering* (ICCEE'2012) held in Dubai, March 24-25, 2012.
[10] This paper is wide-ranging in several ways, however I am conscious of the fact that my examples are mostly from the US. I do not mean to indicate anything by this except my comparative unfamiliarity with specifics in other countries.
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[18] A stylish video by Michel Rigley summarizes some of the aspects of this new information economy. https://vimeo.com/34750078 Accessed 17 December 2013.
[19] *ibid*.
[20] The full video can be found at https://www.youtube.com/watch?v=nbvzbj4Nhtk and other sites. Accessed 17 December 2013.
[21] See for instance Marwick, Alice E., "How Your Data Are Being Deeply Mined," in *The New York Review of Books*, January 9, 2014, http://www.nybooks.com/articles/archives/2014/jan/09/how-your-data-are-being-deeply-mined. Accessed 31 Dec 13.
[22] http://beallcenter.uci.edu/exhibitions/swipe-brooke-singer-beatriz-da-costa-and-jamie-schulte Accessed 17 December 2013.
More information at http://turbulence.org/Works/swipe/main.html Accessed 17 December 2013.
[23] Private communication.
[24] http://technewscast.com/top-news/nsa-installed-spies-virtual-games/
accessed December 9, 2013
[25] Cory Ondrejka is vice president of engineering at Facebook. He also was the Chief Technology Officer of Linden Lab, makers of Second Life. http://en.wikipedia.org/wiki/Cory_Ondrejka accessed 12 Jan 2015
[26] See: *Report of the staffs of the CFTC and SEC to the Joint Advisory Committee on Emerging Regulatory Issues*. September 30, 2010. http://www.sec.gov/news/studies/2010/marketevents-report.pdf, accessed 7 December2013.
[27] http://www.ted.com/talks/kevin_slavin_how_algorithms_shape_our_world.html. Accessed December 29, 13.

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