User Interaction:
Ubiquitous Computing in the age of the Cloud

Associate Professor Donald J. Patterson
INF 133 Fall 2014

Visions of the Future

- We use narratives to help us to make sense of technology

- They help us figure out what makes sense as the next step and what “progress” is

- Different narratives can be contradictory but not necessarily wrong

- Some narratives are wrong because they don’t account for things that we can observe

Virtualization Technology

4 Narrative Visions of the Future of IT

- Technological Determinism
- **Ubiquitous Computing**
- Sterling Transitions
- Collapse Informatics

: What is Ubiquitous Computing?

ubiq·ui·tous *adj* \yü-'bi-kwə-təs\

Definition of UBIQUITOUS

: existing or being everywhere at the same time : constantly encountered : WIDESPREAD <a *ubiquitous* fashion>

— **ubiq·ui·tous·ly** *adverb*
— **ubiq·ui·tous·ness** *noun*

See ubiquitous defined for English-language learners »
See ubiquitous defined for kids »

Examples of UBIQUITOUS

- The company's advertisements are *ubiquitous*.
- <by that time cell phones had become *ubiquitous*, and people had long ceased to be impressed by the sight of one>
- Hot dogs are the ideal road trip food—inexpensive, portable, *ubiquitous*. —Paul Lucas, *Saveur*, June/July 2008

[+]more

www.merriam-webster.com

: The origins of Ubicomp as a academic discipline

The Computer

by Mark Weiser

ory. Today this technology is ubiquitous in industrialized countries. Not only do books, magazines and newspapers convey written information, but so do street signs, billboards, shop signs and even graffiti. Candy wrappers are covered in writing. The constant background presence of these products of "literacy technology" does not require active attention, but the information to be transmitted is ready for use at a glance. It is difficult to imagine modern life otherwise.

Silicon-based information technology, in contrast, is far from having become part of the environment. More than 50 million personal computers have been sold, and the computer nonetheless remains largely in a world of its own. It

MARK WEISER is head of the Computer Science Laboratory at the Xerox Palo Alto Research Center. He is working on the next revolution of computing after workstations, variously known as ubiquitous computing or embodied virtuality. Before working at PARC, he was a professor of computer science at the University of Maryland; he received his Ph.D. from the University of Michigan in 1979. Weiser also helped found an electronic publishing company and a video arts company and claims to enjoy computer programming "for the fun of it." His most recent technical work involved the implementation of new theories of automatic computer memory reclamation, known in the field as garbage collection.

at the Xerox Palo Alto Research Center think that the idea of a "personal" computer itself is misplaced and that the vision of laptop machines, dynabooks and "knowledge navigators" is only a transitional step toward achieving the real potential of information technology. Such machines cannot truly make computing an integral, invisible part of people's lives. We are therefore trying to conceive a new way of thinking about computers, one that takes into account the human world and allows the computers themselves to vanish into the background.

Such a disappearance is a fundamental consequence not of technology but of human psychology. Whenever people learn something sufficiently well, they cease to be aware of it. When you look at a street sign, for example, you absorb its information without consciously performing the act of reading. Computer scientist, economist and Nobelist Herbert A. Simon calls this phenomenon "compiling"; philosopher Michael Polanyi calls it the "tacit dimension"; psychologist J. J. Gibson calls it "visual invariants"; philosophers Hans Georg Gadamer and Martin Heidegger call it the "horizon" and the "ready-to-hand"; John Seely Brown of PARC calls it the "periphery." All say, in essence, that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals.

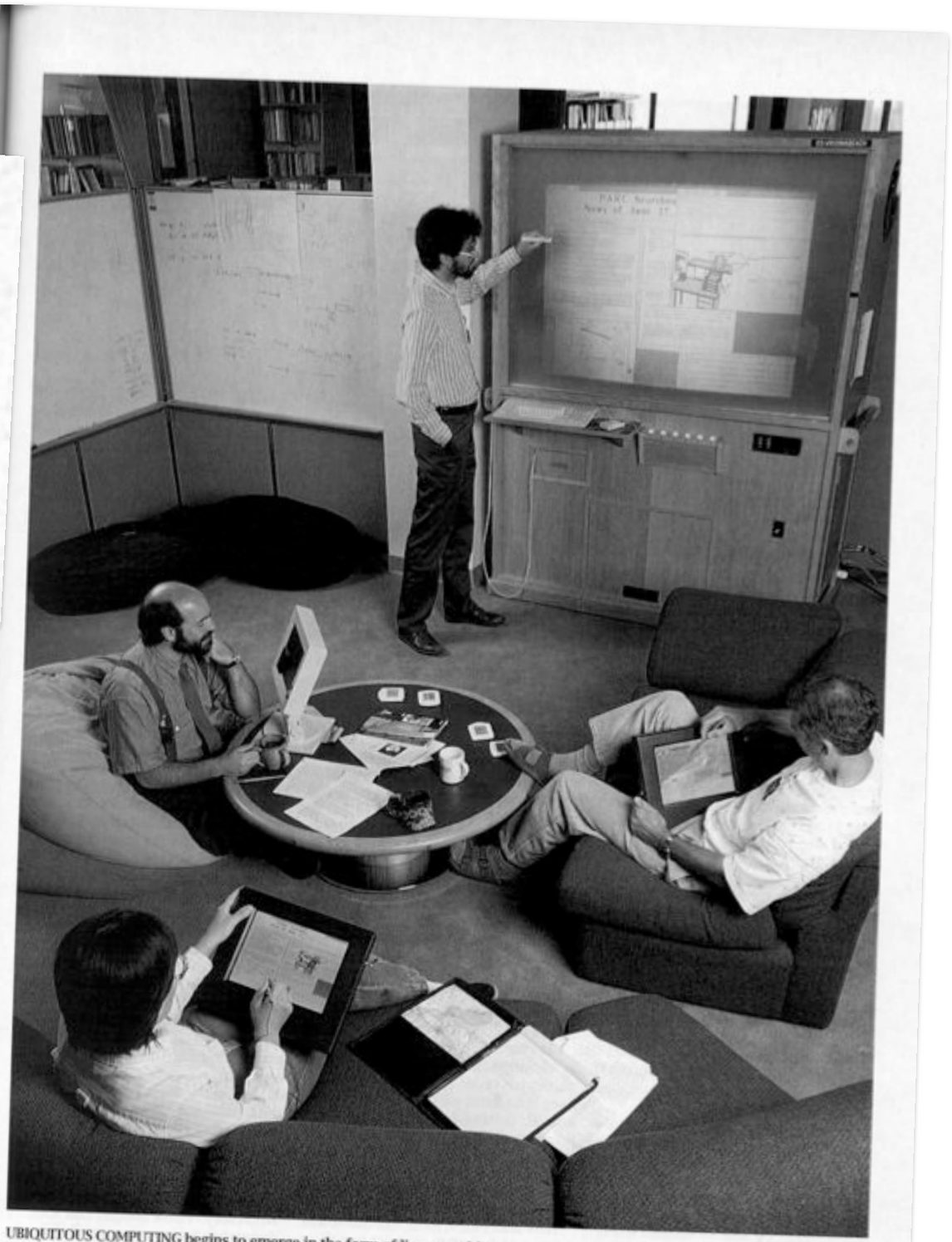
analogy with writing, carrying a super laptop is like owning just one very important book. Customizing this book, even writing millions of other books, does not begin to capture the real power of literacy.

Furthermore, although ubiquitous computers may use sound and video in addition to text and graphics, that does not make them "multimedia computers." Today's multimedia machine makes the computer screen into a demanding focus of attention rather than allowing it to fade into the background.

Perhaps most diametrically opposed to our vision is the notion of virtual reality, which attempts to make a world inside the computer. Users don special goggles that project an artificial scene onto their eyes; they wear gloves or even bodysuits that sense their motions and gestures so that they can move about and manipulate virtual objects. Although it may have its purpose in allowing people to explore realms otherwise inaccessible—the insides of cells, the surfaces of distant planets, the information web of data bases—virtual reality is only a map, not a territory. It excludes desks, offices, other people not wearing goggles and bodysuits, weather, trees, walks, chance encounters and, in general, the infinite richness of the universe. Virtual reality focuses an enormous apparatus on simulating the world rather than on invisibly enhancing the world that already exists.

Indeed, the opposition between the

Reprinted from the September 1991 issue

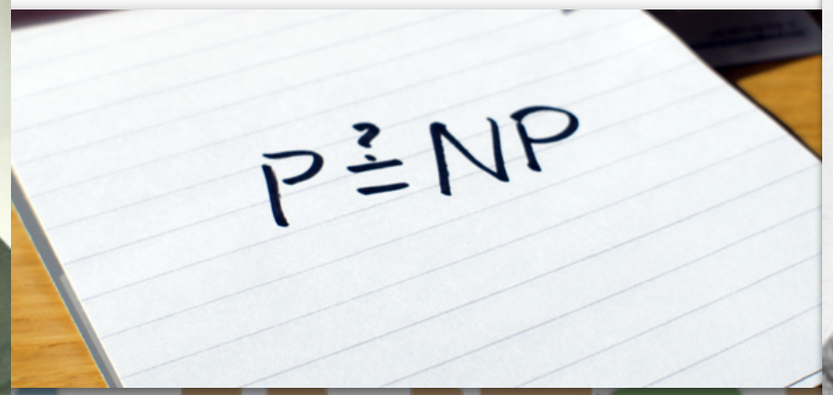


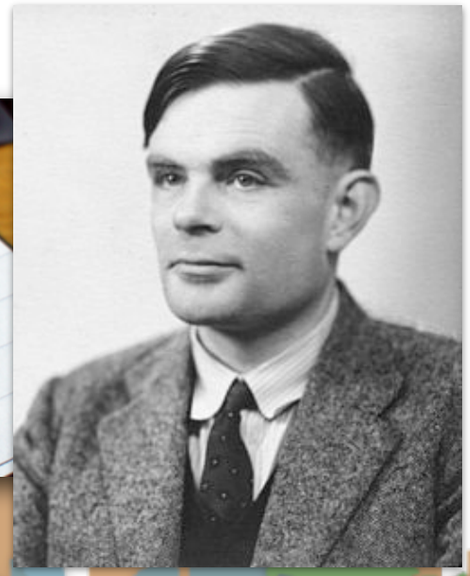
UBIQUITOUS COMPUTING begins to emerge in the form of live boards that replace chalkboards as well as in other devices at the Xerox Palo Alto Research Center. Computer scientists gather around a live board for discussion. Building boards and integrating them with other tools has helped researchers understand better the eventual shape of ubiquitous computing. In conjunction with active badges, live boards can customize the information they display.

0 — 1 — 2 — 3

Zero Wave

- Computerless Computing
  - 1930-1940
  - Computers are theoretical technology
  - Church and Turing establish fundamental limits on computability





http://www.wired.co.uk/news/archive/2010-08/11/p-vs-np-solved

0 — 1 — 2 — 3

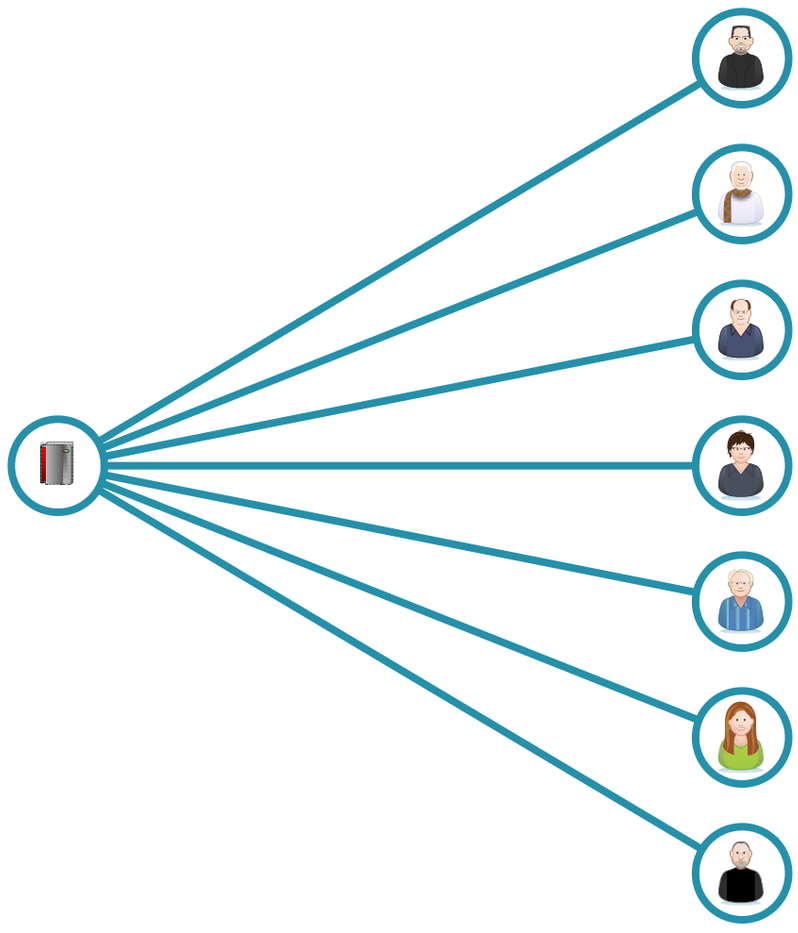
First Wave

- Main Frame Computing
  - 1960-1970
  - Massive computers to do simple data processing
- Few computers in the world

Flickr: http://www.flickr.com/photos/carrick/61952845/in/photostream/

: Ubicomp is about people's relationship to computers

First Wave



0 — 1 — 2 — 3

Second Wave

- Desktop Computing
  - 1980-1990
  - Business applications drive usage
  - One computer per desk
  - Computers connected in intranets to a massive global network
  - All wired

Flickr: http://www.flickr.com/photos/williamhook/486320803/in/photostream/

: Ubicomp is about people's relationship to computers

Second Wave

0 — 1 — 2 — 3

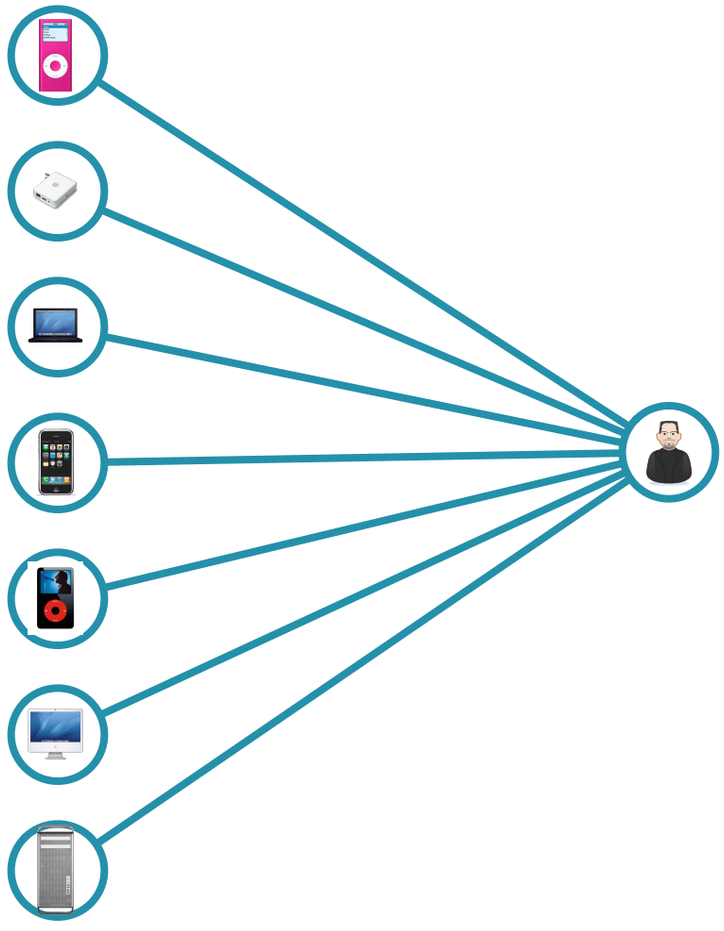
Third Wave

- Ubiquitous Computing
  - 2000 - present
  - Information creation, access, communication drive usage
  - Multiple computers per environment/person
  - WANs, LANs, PANs, ad-hoc networking, wireless
  - Computers disappearing

Flickr: http://www.flickr.com/photos/mckln/3134985100/in/photostream/

: Ubicomp is about people's relationship to computers

Third Wave



Ubicomp is about people's relationship to computers

- virtual reality
  - humans enter the computers world

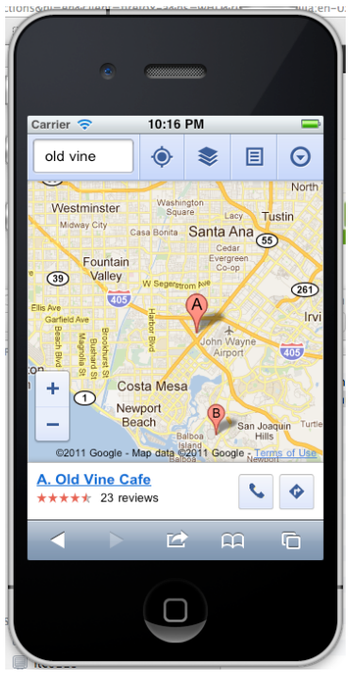
- ubiquitous computing
  - computers enter the human's world

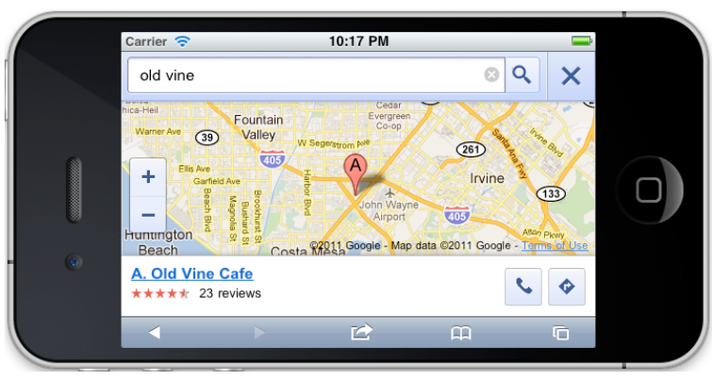
: Ubicomp is about people's relationship to computers

Ubicomp —— Augmented Reality —— Virtual Reality

Virtual Worlds

Mirror Worlds





[ar photo](), [vr photo](), [green photo]()

Summary

- Technologies are becoming more embedded, seamless and “invisible”
- Technology progresses in waves based on scale

Ubiquitous Computing as an IT Narrative

Freeband Video

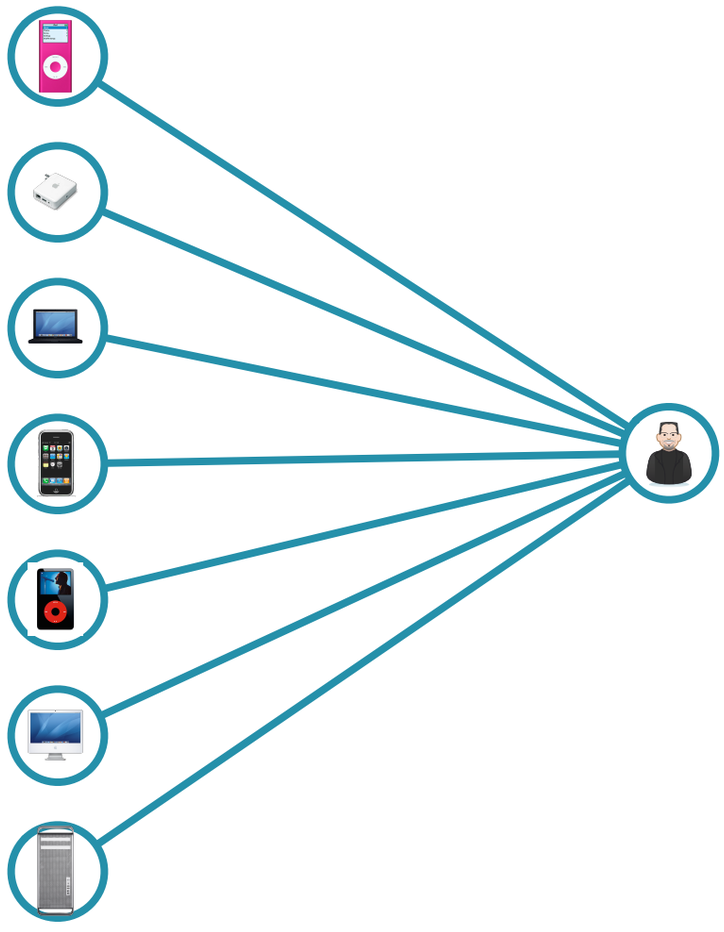
- Technologies are becoming more embedded, seamless and “invisible”
- Technology progresses in waves based on scale

What is the 4th wave?

Is ubiquitous computing the same as cloud computing?

: Ubicomp is about people's relationship to computers

Third Wave



How are we going to manage all of these devices?

Who is going to manage all of these devices?

Who is going to manage the infrastructure when the computers enter the human's world?

The professionals!

Enter cloud computing....

Cloud computing

is several

{visions, architectures, infrastructures}

that transform computing from a

{capital investment, product}

into a

{utility, service}

Cloud computing

is an

infrastructure

that transform computing from a

capital investment

into a

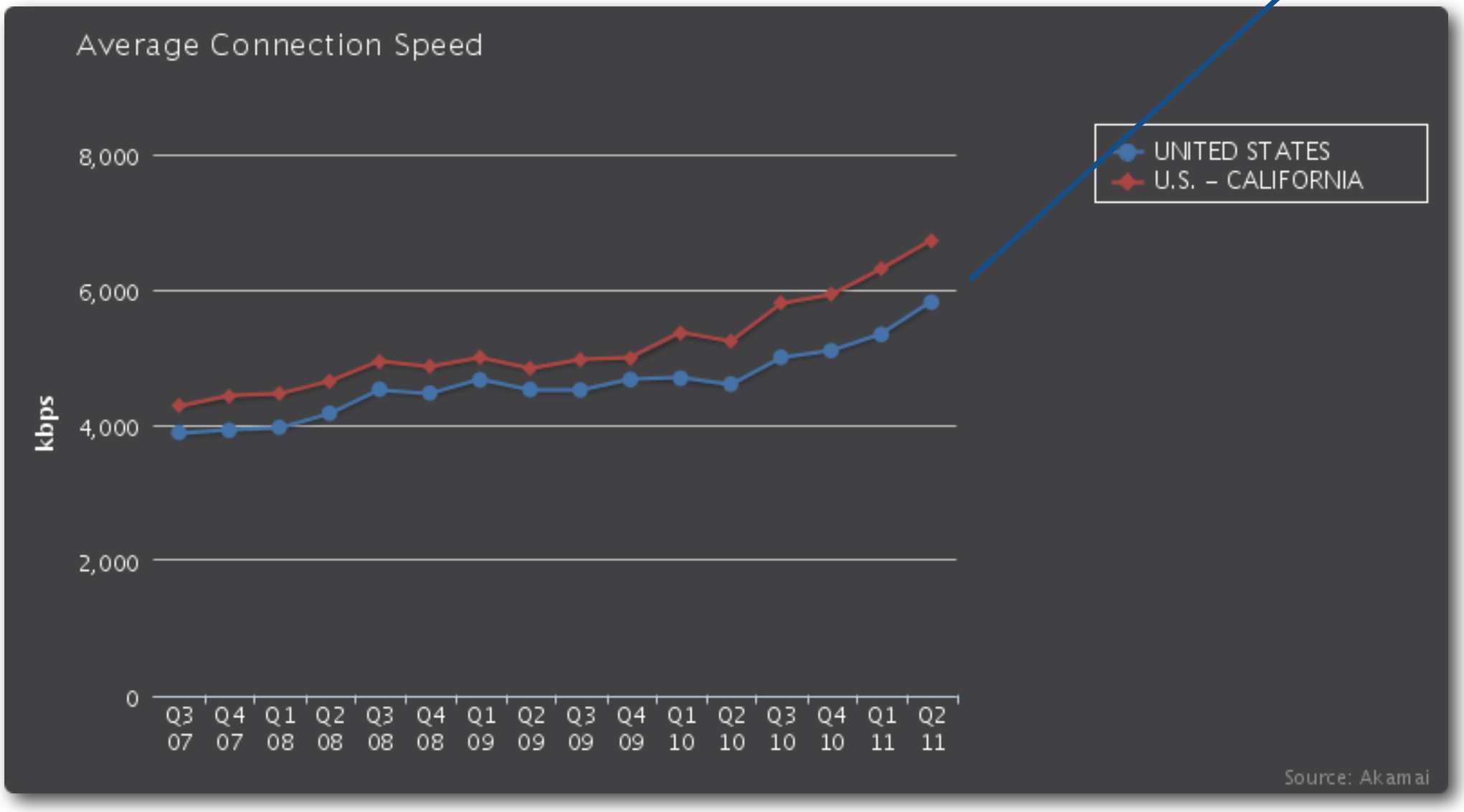
utility

Why now? What has changed?

- Connectivity
- Smart phones
- System Virtualization
- Security Threats
- Sentient browser applications

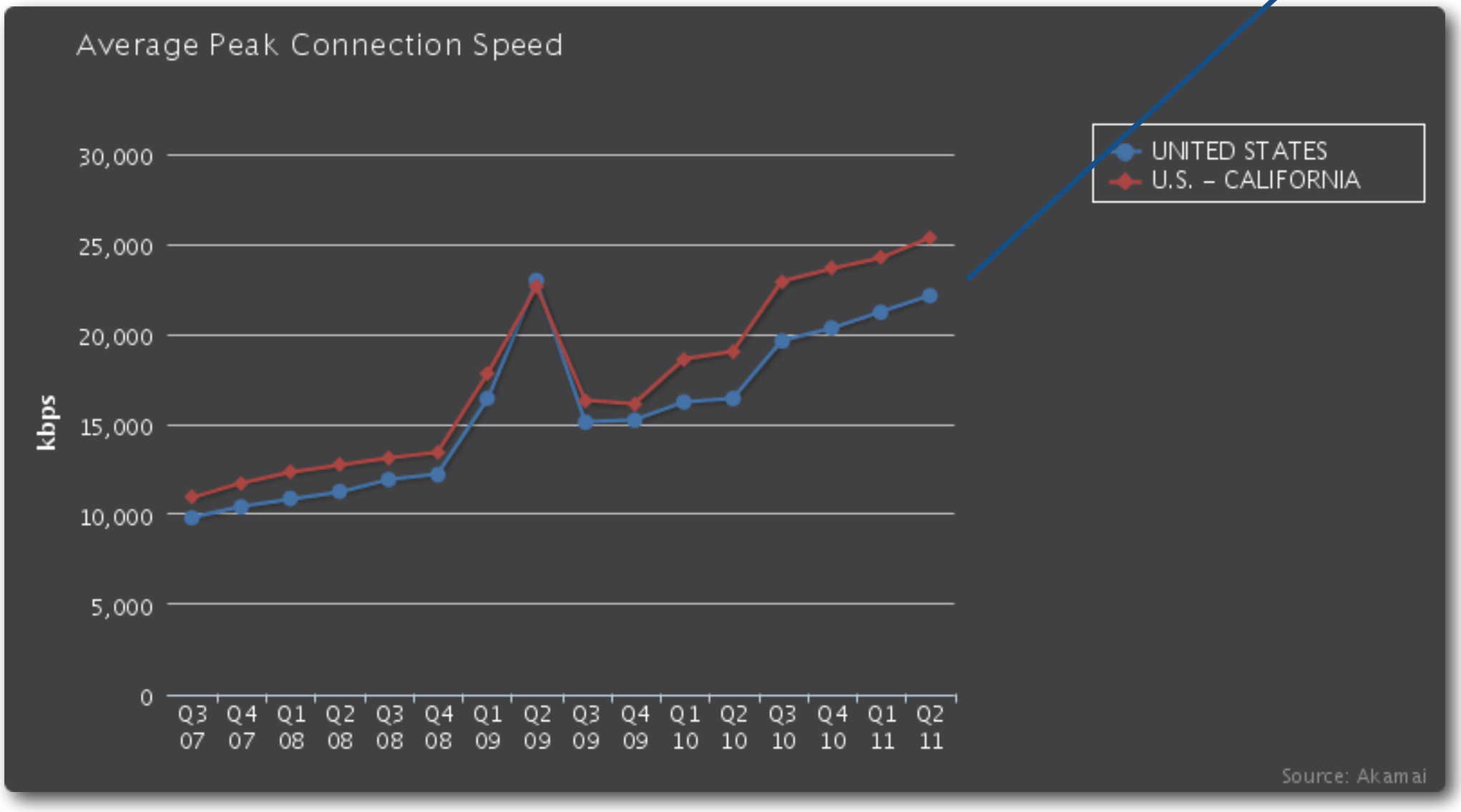
Connectivity

Q2 ’14 US = 11,400



Connectivity

Q2 '14 US = 45,300



Which country has the fastest mobile broadband?

South Korea

(15.2 Mbps average Q2 ‘14)

Australia

(108.0 <bps highest average peak connection speed Q2 ‘14)

“average connection speeds increased by more than 100% year-over-year at 22 mobile providers” (2011)
-akamai

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Smart Phones

The mobile penetration divide

In some parts of Africa, five people share the same phone. In Italy, almost every adult has at least two mobile devices. How penetration varies by region,

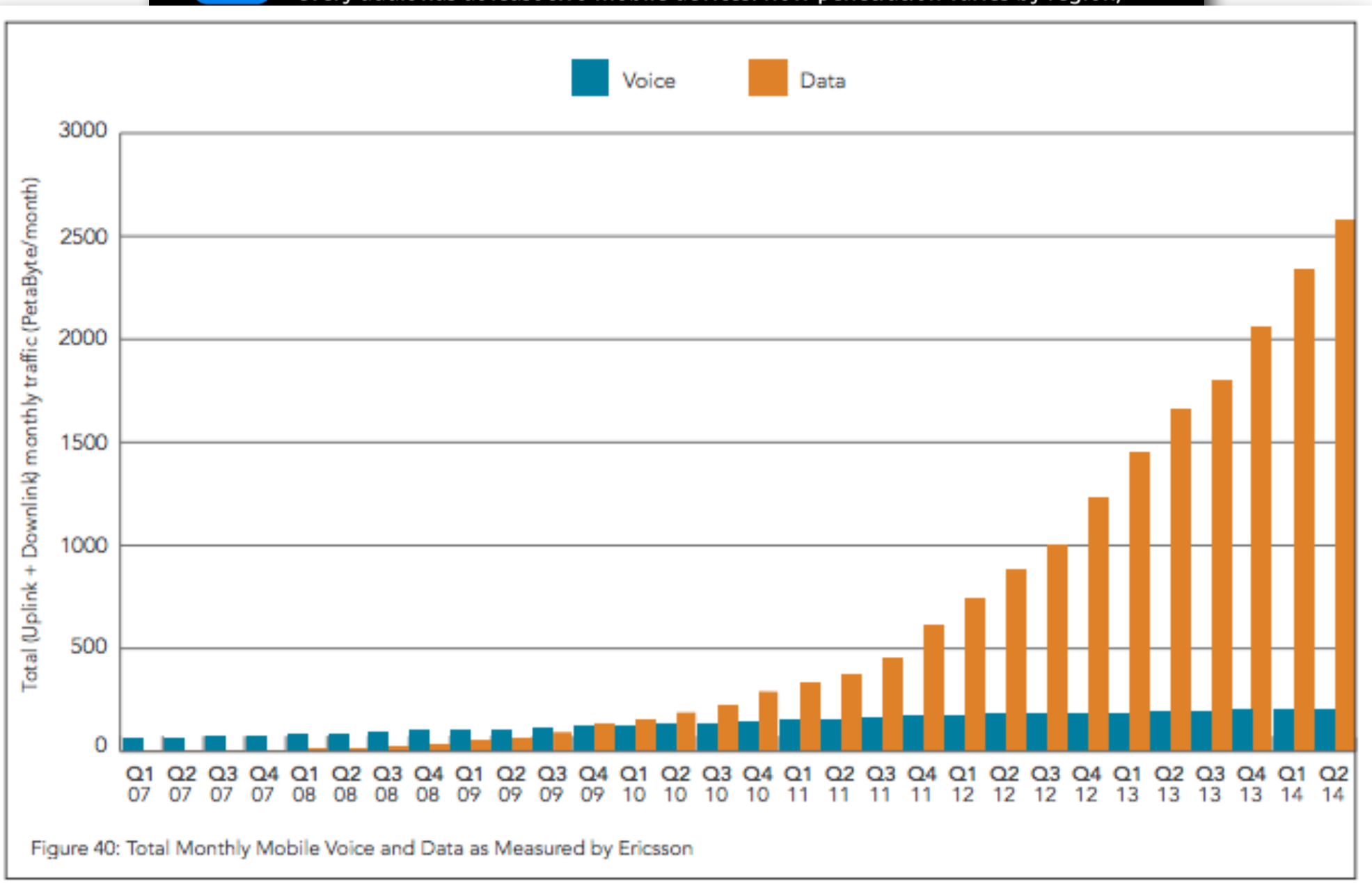

Figure 40: Total Monthly Mobile Voice and Data as Measured by Ericsson

Notes: 1. Estimate 2. Commonwealth of Independent States

The Official Nokia Blog

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Virtualization Technology

Windows 7 Running in a Virtual Machine on a Mac

Virtualization Technology

Commercial

vmware®

Parallels™

Open Source

ORACLE VirtualBox

Xen®

Powers Amazon,
Rackspace, Linode, etc.

What is virtualization good for?

- Efficiency
  - Fully utilize “bare-metal” host hardware
  - Suddenly 8 cores seems reasonable
- Portability
  - Move a virtual machine to another host
  - Perhaps without telling anyone
- Isolation
  - One machine doesn’t effect another
- Run multiple OS’s at the same time
- Supports disposal computers

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Security Threats

China, U.S., Israel

- Pros
  - Nation states
  - Very smart people
  - Unlimited Resources
  - Motivated by political/military goals
- Semi-pros
  - Organized crime
  - Motivated by money
- Amateurs
  - Motivated by bragging rights

Anonymous, LulzSec

Security Threats

	Country/Region	Q2 '14 Traffic %	Q1 '14 %
1	China	43%	41%
2	Indonesia	15%	6.8%
3	United States	13%	11%
4	Taiwan	3.7%	3.4%
5	India	2.1%	2.6%
6	Russia	2.0%	2.9%
7	Brazil	1.7%	3.2%
8	South Korea	1.4%	1.6%
9	Turkey	1.2%	1.7%
10	Romania	1.2%	1.6%
–	Other	16%	25%

Figure 1: Attack Traffic, Top Originating Countries
(by source IP address, not attribution)

Port	Port Use	Q2 '14 Traffic %	Q1 '14 %
80	WWW (HTTP)	15%	8.0%
445	Microsoft-DS	14%	14%
23	Telnet	10%	8.7%
443	SSL (HTTPS)	7.7%	2.9%
1433	Microsoft SQL Server	6.7%	2.3%
8080	HTTP Alternate	5.5%	1.5%
3389	Microsoft Terminal Services	4.3%	2.8%
22	SSH	3.4%	2.0%
3306	MySQL	2.1%	0.5%
135	Microsoft-RPC	1.9%	1.0%
Various	Other	29%	–

Figure 2: Attack Traffic, Top Ports

Akamai FASTER FORWARD
www.stateoftheinternet.com

Why now? What has changed?

- Connectivity
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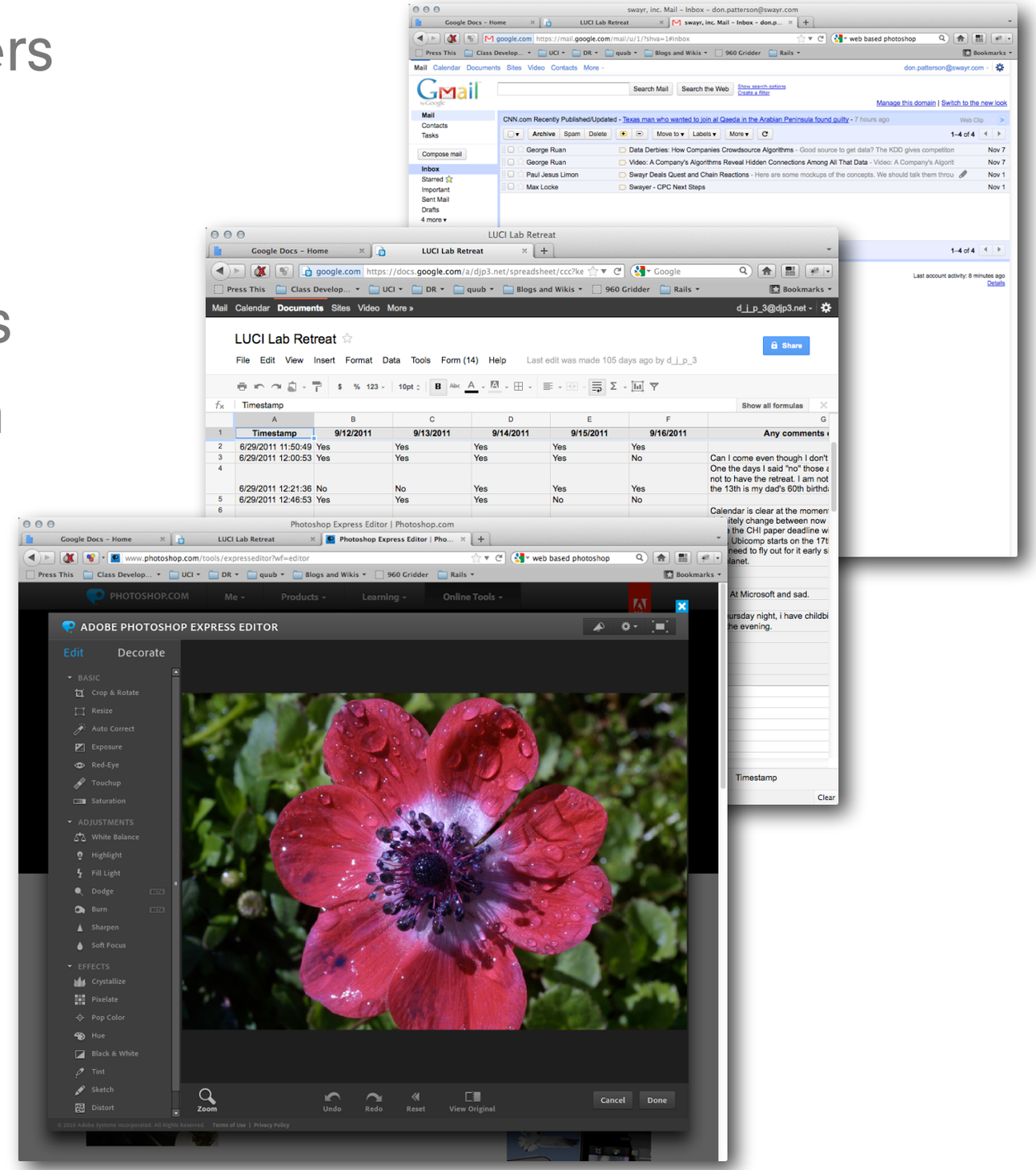
Sentient browser applications

- Sentient Applications
  - Programs that people spend time working with
- Enabled by modern browsers
  - Offline storage
  - Web sockets
    - Real-time push updates
    - Real-time collaboration
  - Fast client-side Javascript
- Examples
  - Hotmail
  - Google Docs
  - Photoshop Express



Why now? What has changed?

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I can always reach any computer in the world at high-speed wirelessly

So, now the landscape has changed

Why now? What has changed?

- Connectivity
- Smart phones
- System Virtualization
- Security Threats
- Sentient browser applications

I have a device in my pocket that can be a decent interface to any other computer in the world

So, now the landscape has changed

Why now? What has changed?

- Connectivity
- Smart phones
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It is very cheap to run powerful computers in consolidated data centers

So, now the landscape has changed

Why now? What has changed?

- Connectivity
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It requires professionals to keep computers and data secure when being attacked by sophisticated enemies

So, now the landscape has changed

Why now? What has changed?

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I don't need to be able to run a program natively. I'd rather run the latest program released every day.

So, now the landscape has changed

Why now? What has changed?

- First wave
  - It was cheaper to share a mainframe
- Second wave
  - It was cheaper to have your own desktop
- Third wave
  - It is cheaper to rent computation from the cloud

What are the visions?

- Consumer
  - Don't think about the cloud
- Services
  - Always available apps
- Infrastructure
  - Build with our tech services
- Virtual Machines
  - Rent a cloud computer

amazon web services™

heroku

rackspace HOSTING

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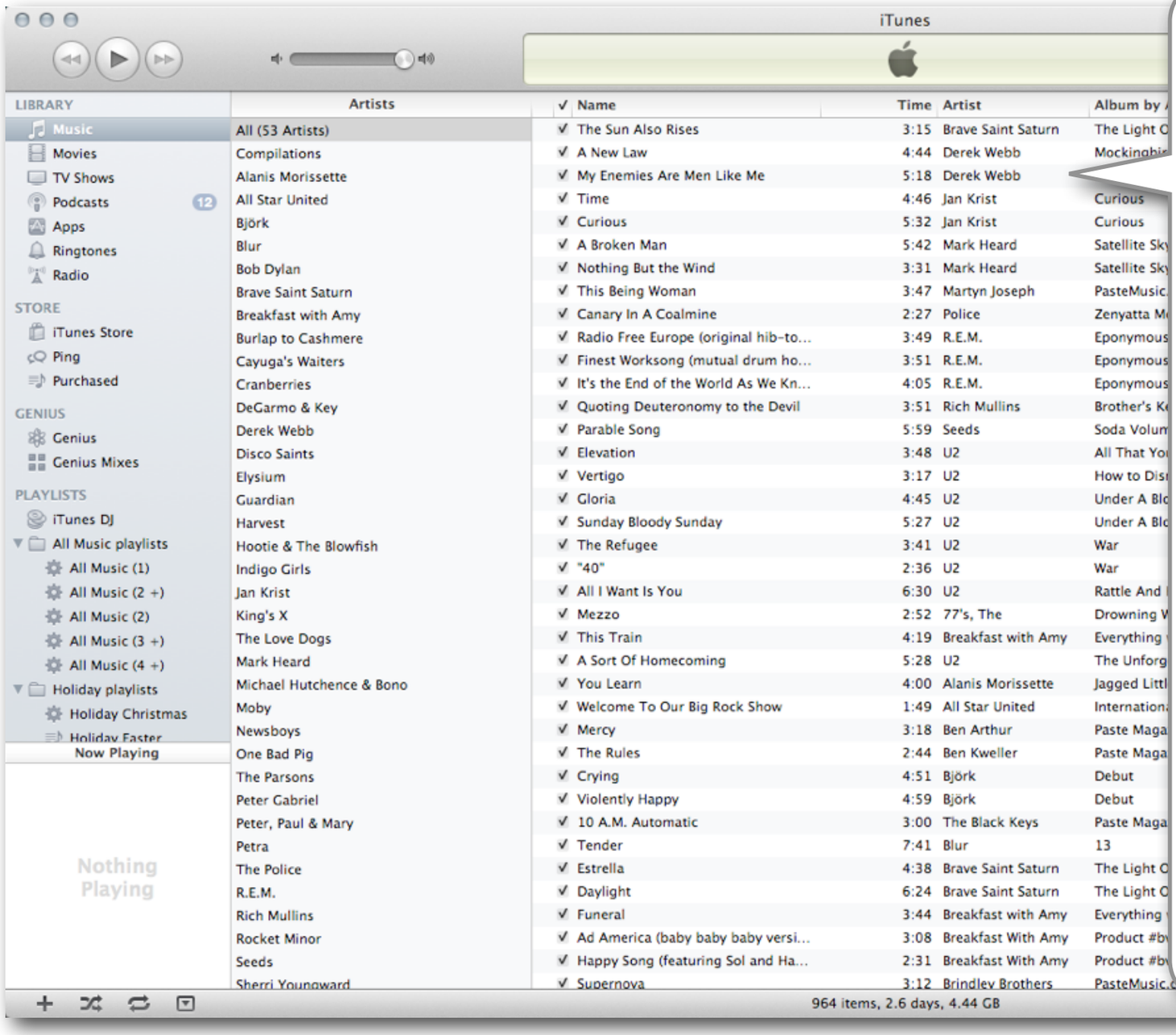
Consumer vision : iTunes Match



Your music, movies, television are always there on every Apple device.

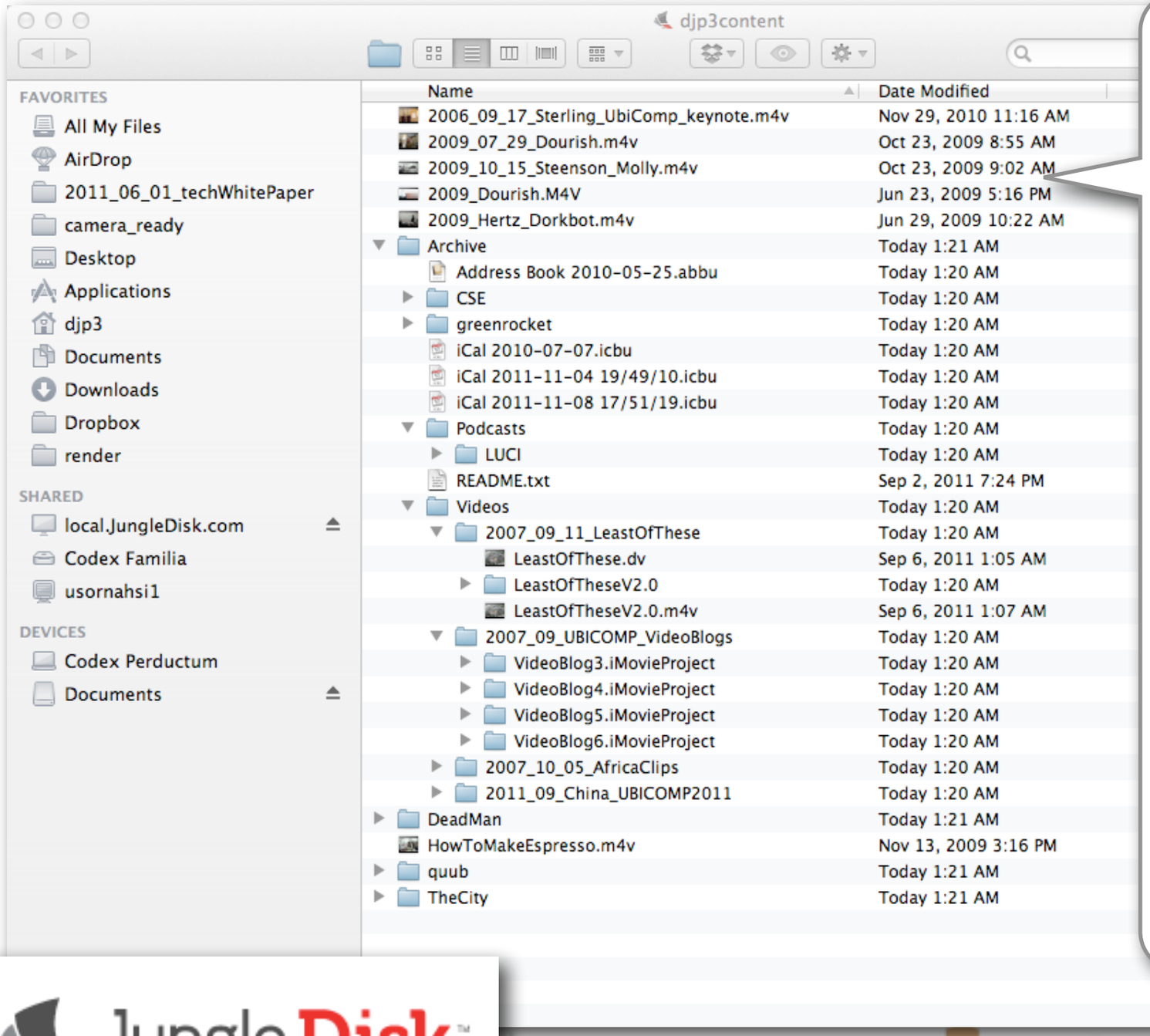
Consumers don't know how it gets there.

(It is all backed by an Apple data center)

And now that it is in the cloud there is no more syncing, no more worrying about disk space, no more worrying about back ups.

$25.00 a year

Consumer vision : JungleDisk



An infinitely large hard-drive that never crashes

Consumers don't know where the data is kept.

(It is all backed by an Amazon data center)

Any data that you need is available on demand. Caching supports fast access

$0.14 GB/month + txfr

JungleDisk™

What are the visions?

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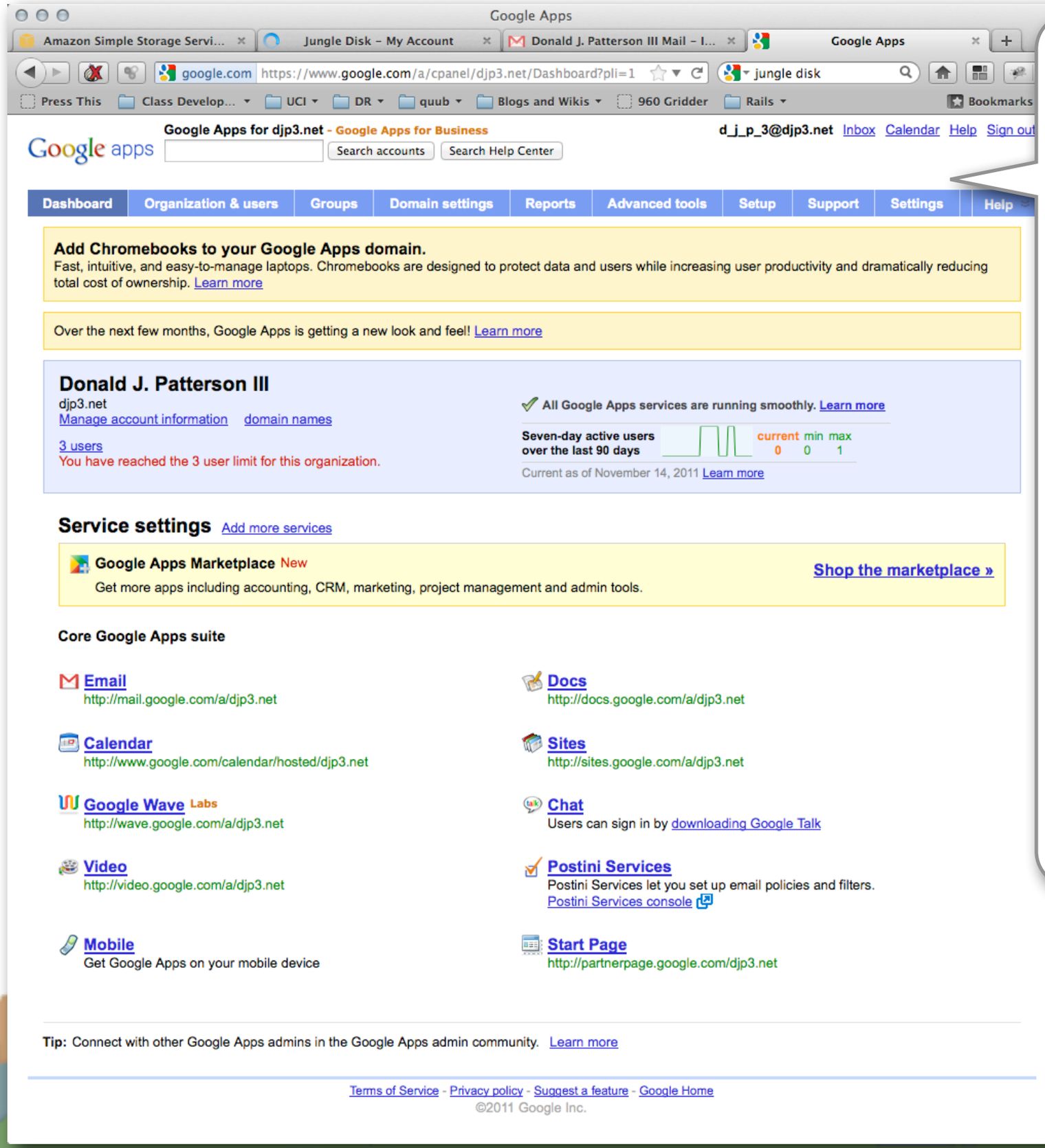
Services vision : Google Apps



A suite of collaborative business apps including email, calendar, word processing, spreadsheet, "powerpoint", chat

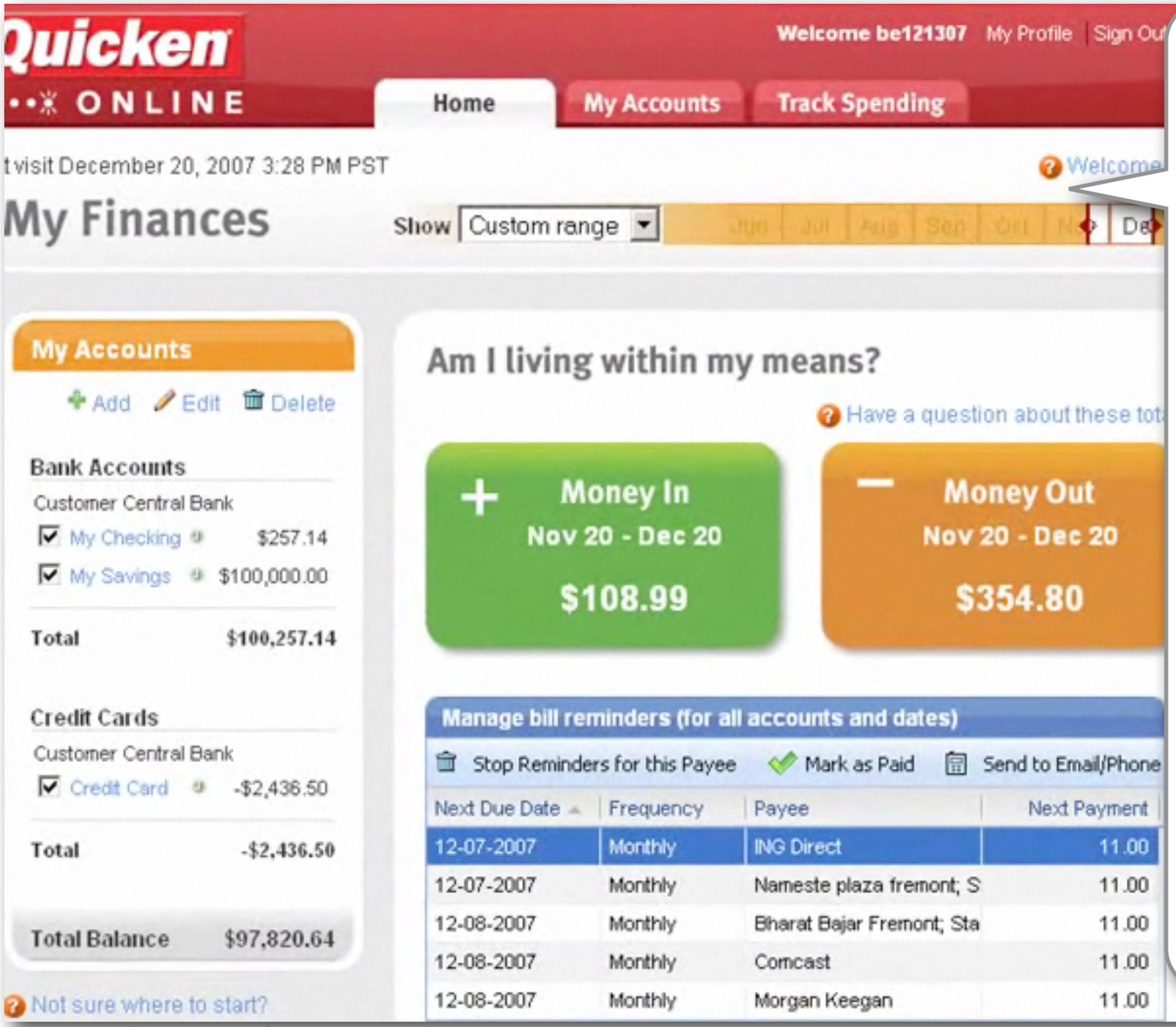
No limit on storage, no ads, no software updating, no security management, no downtime

(It is all backed by Google's data center)

Always on, available from any browser

$50.00 per user/per year

Services vision : Quicken Online



Manage your money and finances online. Quicken connects to banks for you.

No backups, no hacker break-ins.

(It is all backed by ?'s data center)

Always on, available from any browser

$2.99/per year

What are the visions?

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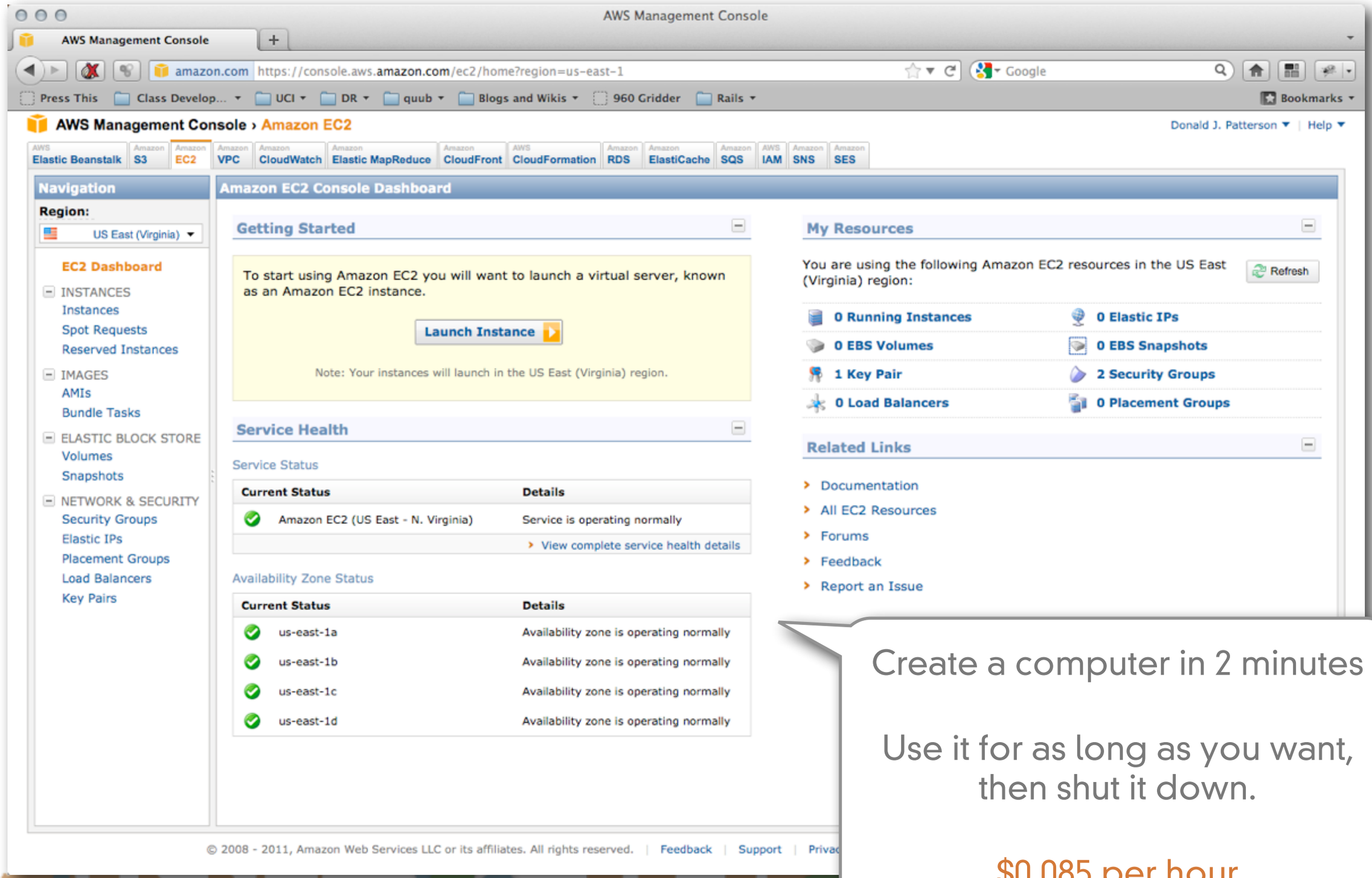
Infrastructure: Amazon web services

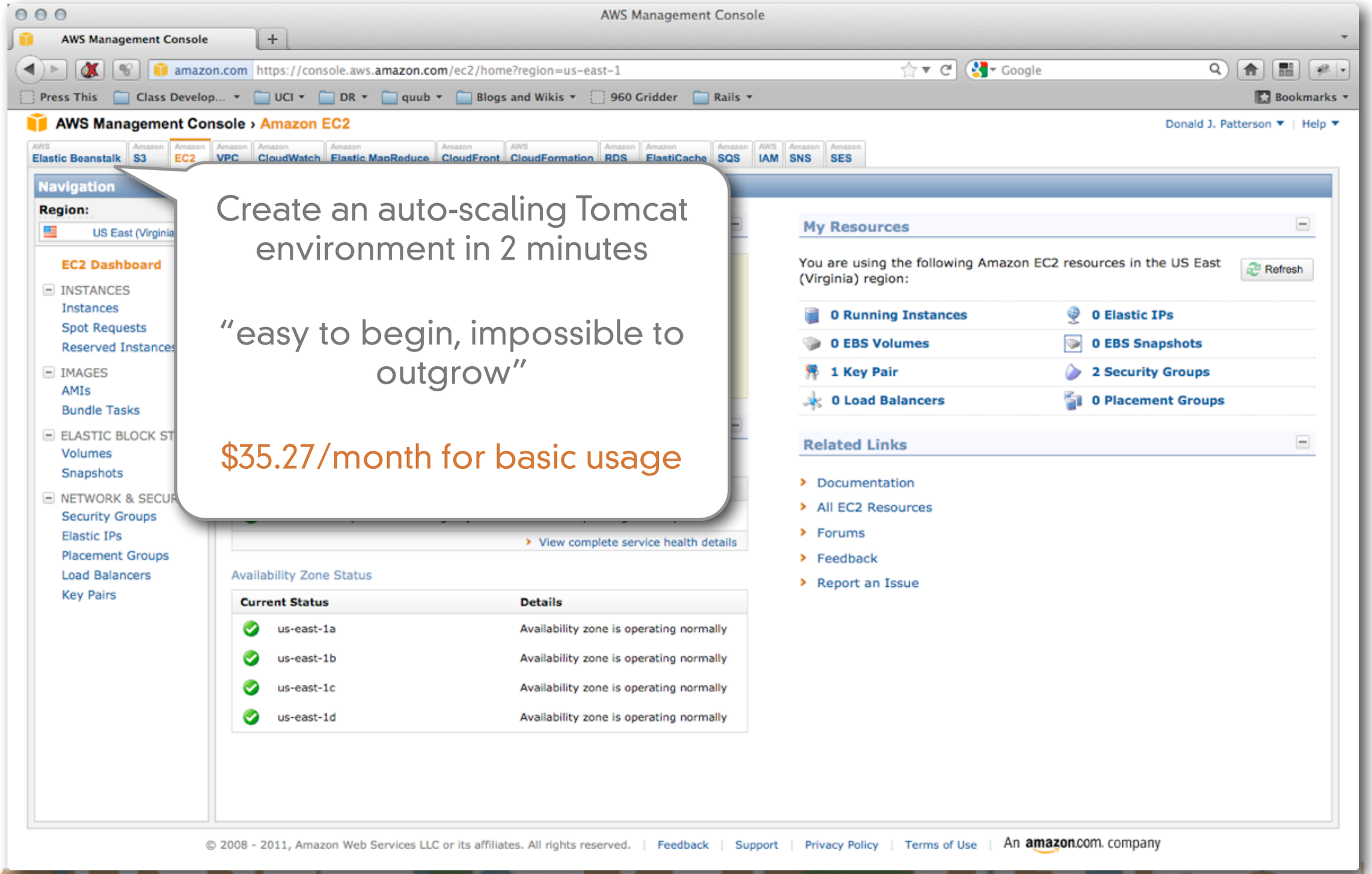


Create a computer in 2 minutes

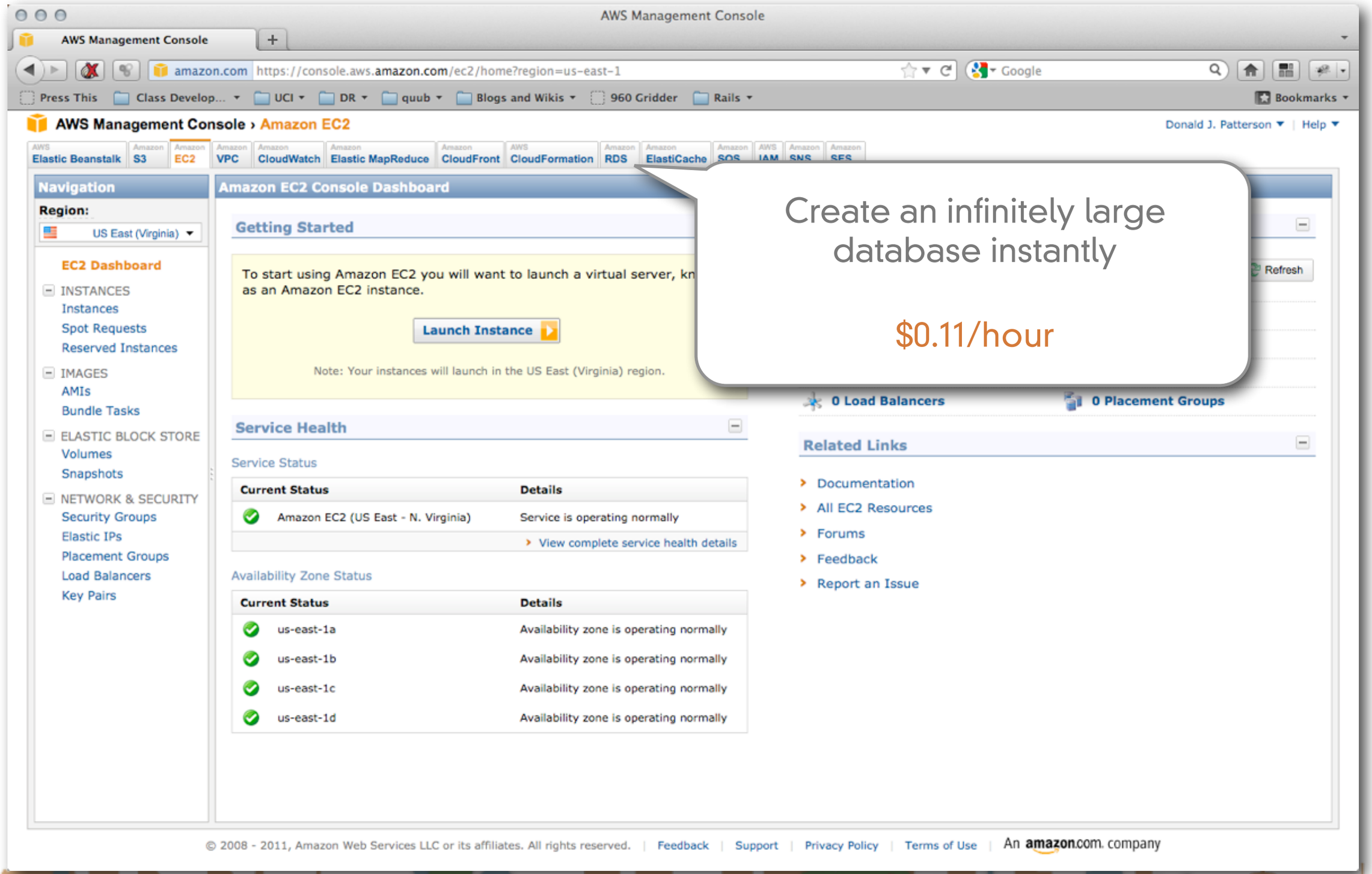
Use it for as long as you want, then shut it down.

$0.085 per hour
($744 per year)

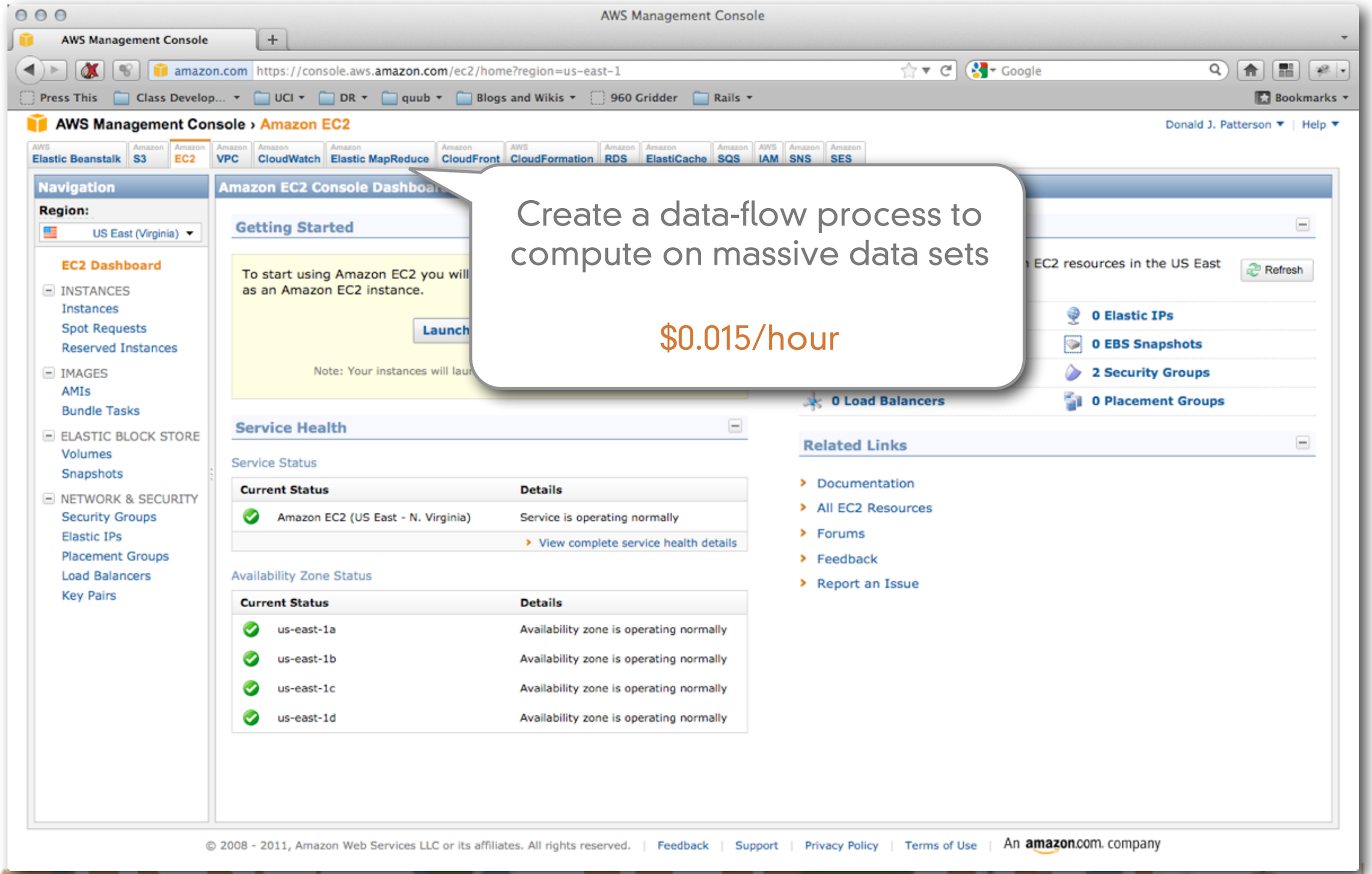
Infrastructure: Amazon web services



Infrastructure: Amazon web services



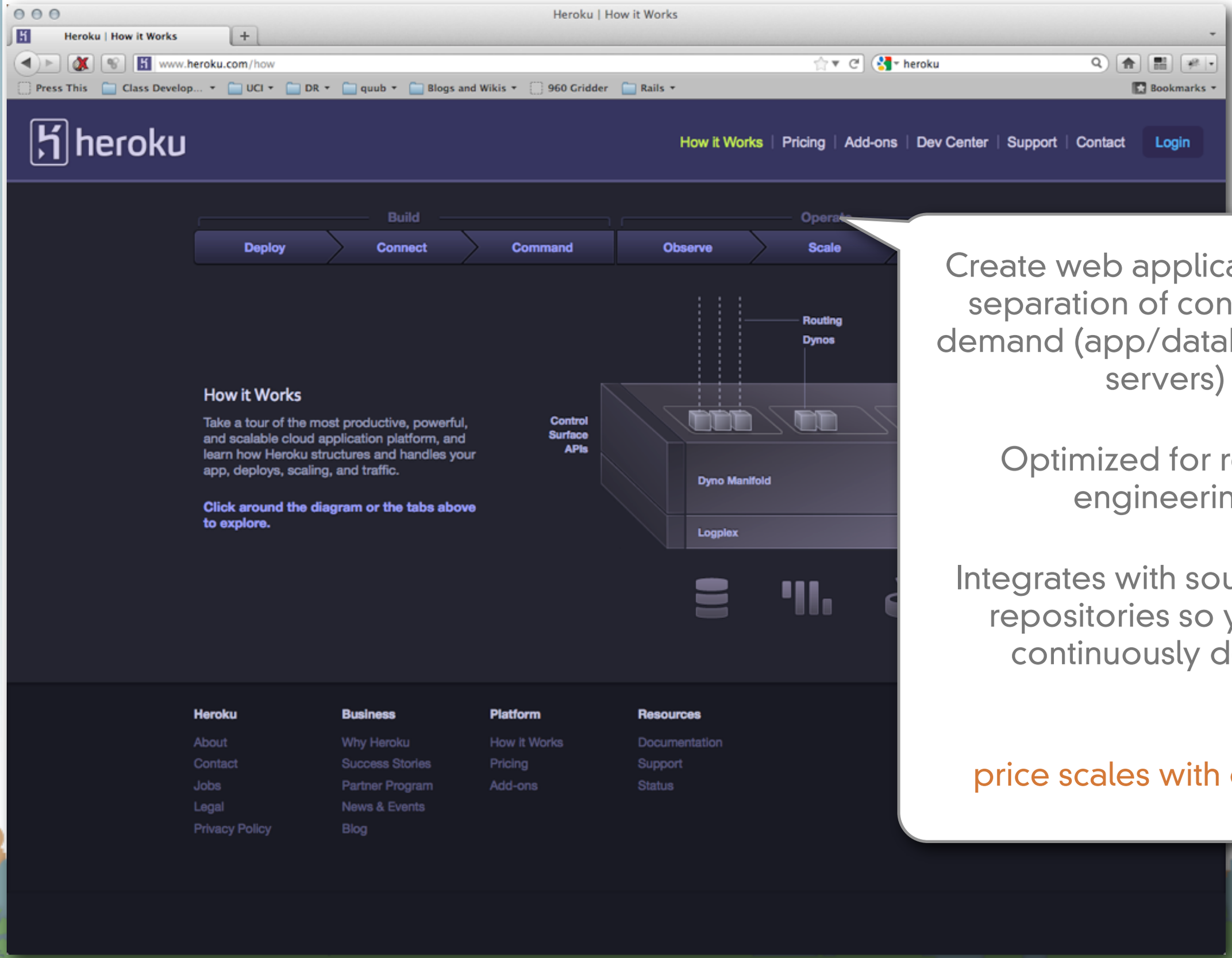
Infrastructure: Amazon web services



Create a data-flow process to compute on massive data sets

$0.015/hour

Infrastructure: Heroku platform services



Create web applications with separation of concerns on demand (app/database/asset servers)

Optimized for release engineering

Integrates with source code repositories so you can continuously deploy

price scales with demand

What are the visions?

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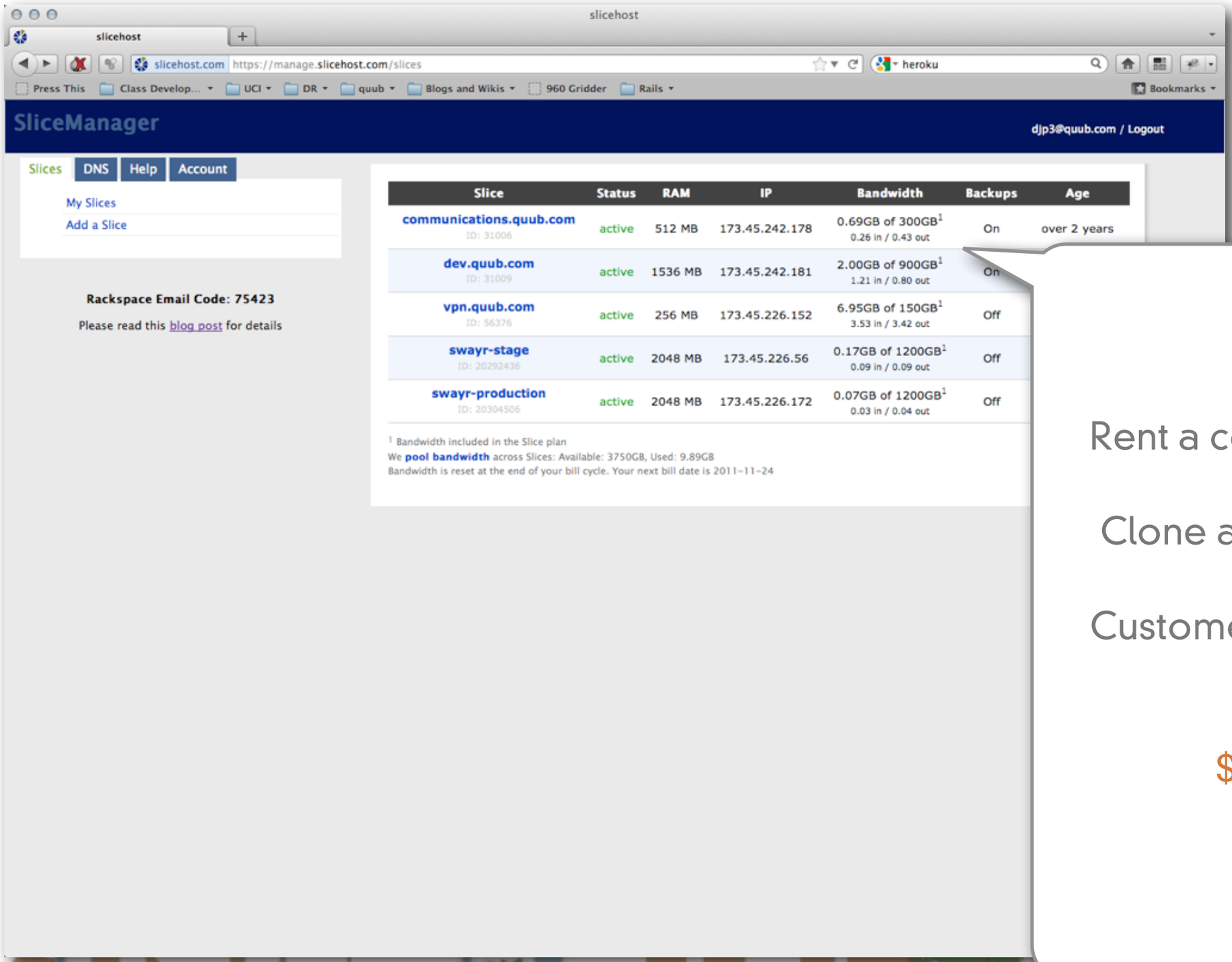
rackspace® HOSTING

linode.com

Virtual Machines: Slicehost



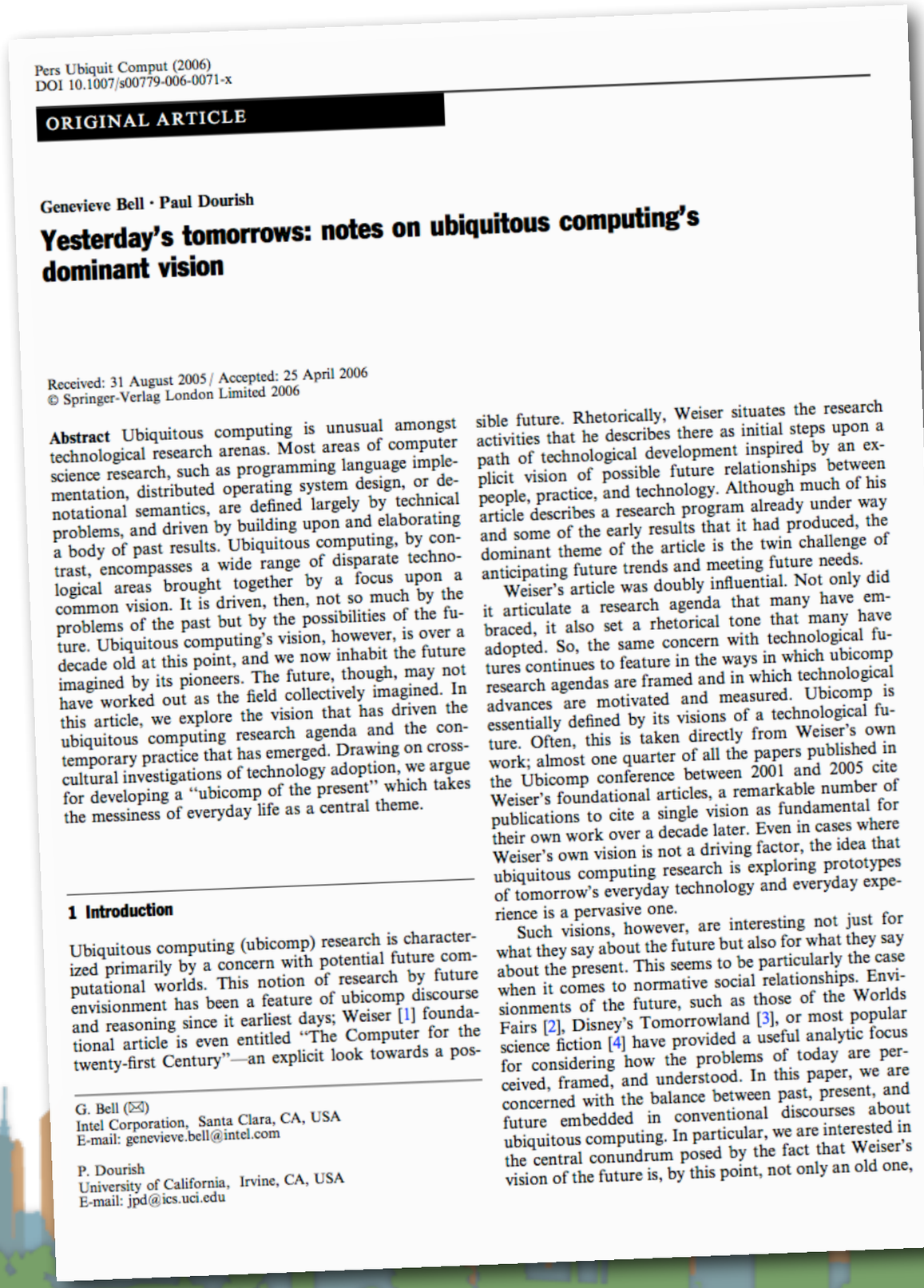
Rent a computer on demand

Clone an existing computer

Customer does all the admin

$40.00 / month

Yesterday's Tomorrows



Pers Ubiquit Comput (2006)
DOI 10.1007/s00779-006-0071-x

ORIGINAL ARTICLE

Genevieve Bell · Paul Dourish

Yesterday's tomorrows: notes on ubiquitous computing's dominant vision

Received: 31 August 2005 / Accepted: 25 April 2006
© Springer-Verlag London Limited 2006

Abstract Ubiquitous computing is unusual amongst technological research arenas. Most areas of computer science research, such as programming language implementation, distributed operating system design, or denotational semantics, are defined largely by technical problems, and driven by building upon and elaborating a body of past results. Ubiquitous computing, by contrast, encompasses a wide range of disparate technological areas brought together by a focus upon a common vision. It is driven, then, not so much by the problems of the past but by the possibilities of the future. Ubiquitous computing's vision, however, is over a decade old at this point, and we now inhabit the future imagined by its pioneers. The future, though, may not have worked out as the field collectively imagined. In this article, we explore the vision that has driven the ubiquitous computing research agenda and the contemporary practice that has emerged. Drawing on cross-cultural investigations of technology adoption, we argue for developing a "ubicomp of the present" which takes the messiness of everyday life as a central theme.

1 Introduction

Ubiquitous computing (ubicomp) research is characterized primarily by a concern with potential future computational worlds. This notion of research by future envisionment has been a feature of ubicomp discourse and reasoning since it earliest days; Weiser [1] foundational article is even entitled "The Computer for the twenty-first Century"—an explicit look towards a possible future. Rhetorically, Weiser situates the research activities that he describes there as initial steps upon a path of technological development inspired by an explicit vision of possible future relationships between people, practice, and technology. Although much of his article describes a research program already under way and some of the early results that it had produced, the dominant theme of the article is the twin challenge of anticipating future trends and meeting future needs.

Weiser's article was doubly influential. Not only did it articulate a research agenda that many have embraced, it also set a rhetorical tone that many have adopted. So, the same concern with technological futures continues to feature in the ways in which ubicomp research agendas are framed and in which technological advances are motivated and measured. Ubicomp is essentially defined by its visions of a technological future. Often, this is taken directly from Weiser's own work; almost one quarter of all the papers published in the Ubicomp conference between 2001 and 2005 cite Weiser's foundational articles, a remarkable number of publications to cite a single vision as fundamental for their own work over a decade later. Even in cases where Weiser's own vision is not a driving factor, the idea that ubiquitous computing research is exploring prototypes of tomorrow's everyday technology and everyday experience is a pervasive one.

Such visions, however, are interesting not just for what they say about the future but also for what they say about the present. This seems to be particularly the case when it comes to normative social relationships. Envisionments of the future, such as those of the Worlds Fairs [2], Disney's Tomorrowland [3], or most popular science fiction [4] have provided a useful analytic focus for considering how the problems of today are perceived, framed, and understood. In this paper, we are concerned with the balance between past, present, and future embedded in conventional discourses about ubiquitous computing. In particular, we are interested in the central conundrum posed by the fact that Weiser's vision of the future is, by this point, not only an old one,

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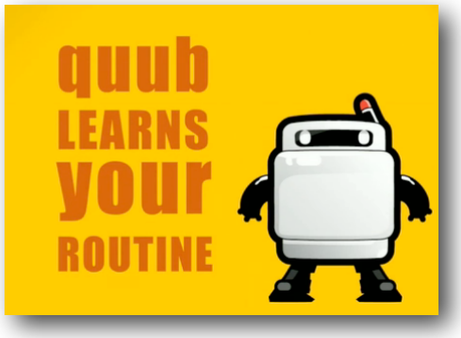
- The rhetoric is clean, the reality is messy
- If we aren't careful we'll miss the progress
- Many places in the world have a different experience of computing

What is my experience?

- http://www.quub.com
- http://whisper.fm
- http://swayr.com
- http://waitscout.com



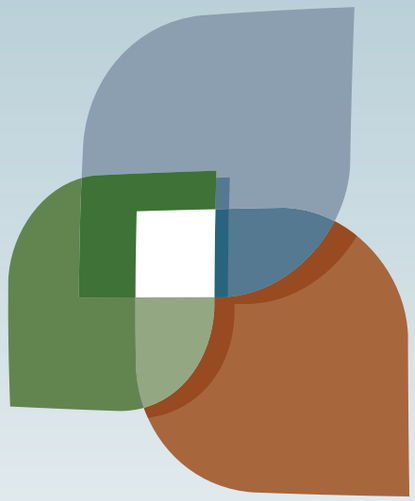
What is my experience?

- Robustness is hard
  - Ambulance
  - Latency works against you
- Dealing with venture capitalists is rough
  - selling the future (bump)
  - “build a great company”
- Challenges of working in China
  - microblog monitoring
  - copied the product
  - car logger

What is my experience?

- “this is too futuristic for us”
- Other thoughts
  - geographical domain and legislation hasn’t caught up yet with cloud abstractions
  - It’s not actually a cloud - it consumes resources
- The movie Avatar create 1 petabyte of data

Poll



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