UbiComp In The Clouds: Observations, Reflections and Experiences

Donald J. Patterson
Donald Bren School of Information and Computer Sciences
Department of Informatics
Laboratory for Ubiquitous Computing and Interaction

INF 241
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http://www.ics.uci.edu/~djp3

: My Background

- B.S., Computer Science from Cornell (NY)
  - M.Eng, Electrical Engineering
- STRIKE Officer
  - USS CURTIS WILBUR, DDG-54, Japan
- Operations Officer
  - USS SIMON LAKE, AS-33, Italy
- Ph.D in Computer Science and Engineering at UW
- Director of the Laboratory for Ubiquitous Computing and Interaction
- Co-founder of quub, whisper.fm, swayr

: What is Ubiquitous Computing?

: 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

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The Computer for the 21st Century

Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence

by Mark Weiser

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

Consider writing, perhaps the first information technology. The ability to represent spoken language symbolically for long-term storage freed information from the limits of individual memory. 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 is approachable only through complex jargon that has nothing to do with the tasks for which people use computers. The state of the art is perhaps analogous to the period when scribes had to know as much about making ink or baking clay as they did about writing.

The arcane aura that surrounds personal computers is not just a "user interface" problem. My colleagues and I 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.

The idea of integrating computers seamlessly into the world at large runs counter to a number of present-day trends. "Ubiquitous computing" in this context does not mean just computers that can be carried to the beach, jungle or airport. Even the most powerful notebook computer, with access to a worldwide information network, still focuses attention on a single box. By analogy with writing, carrying a superlaptop 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

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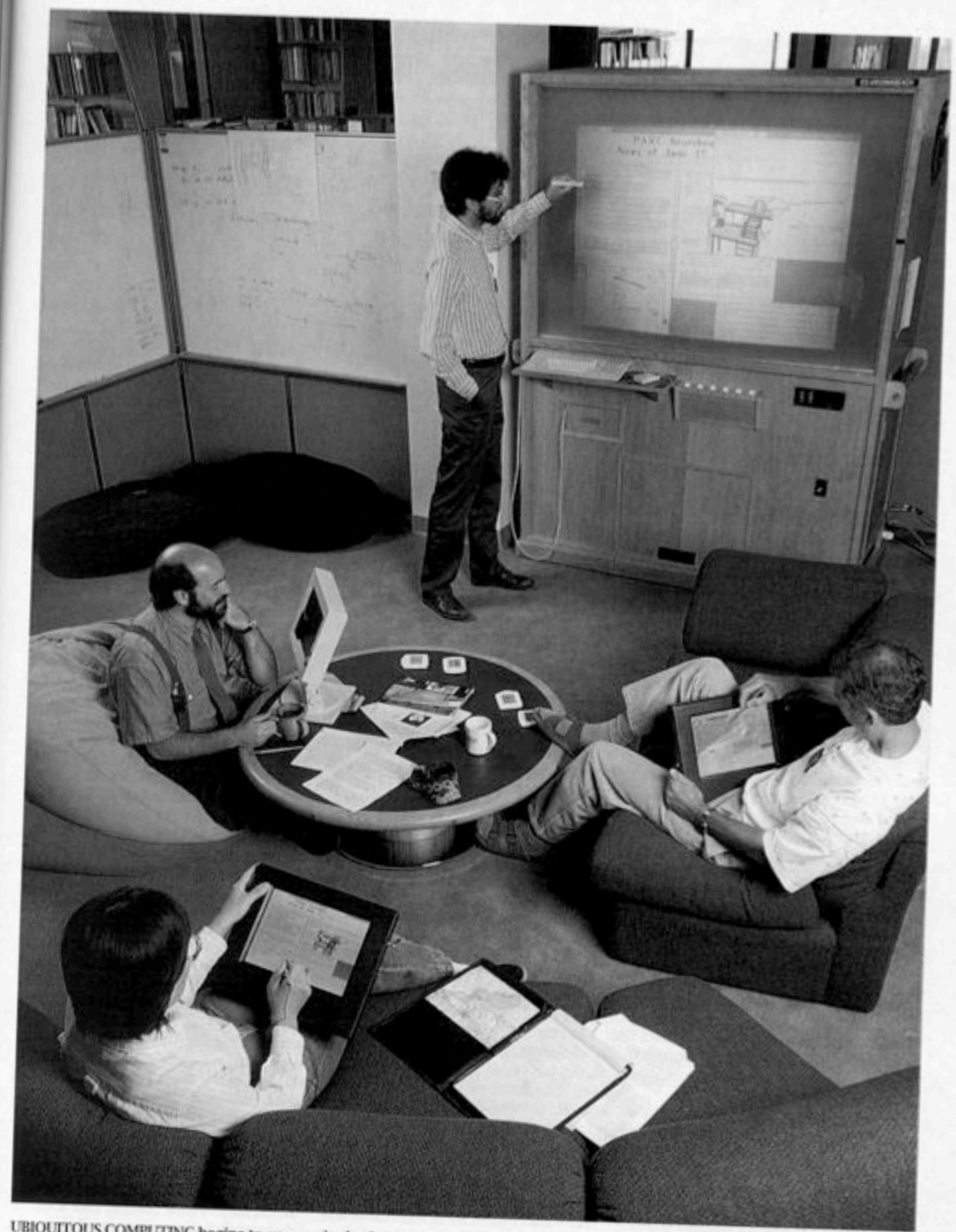

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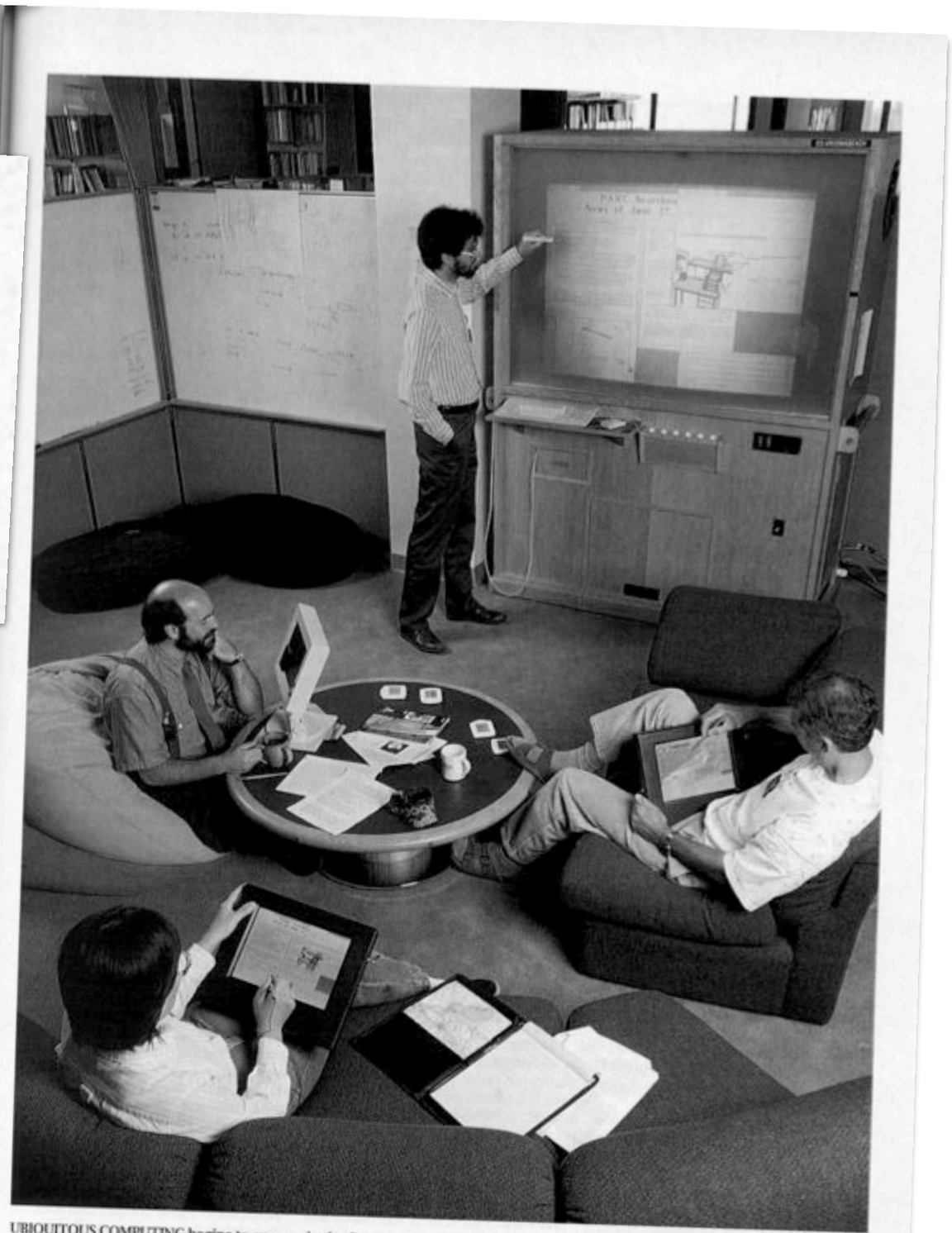

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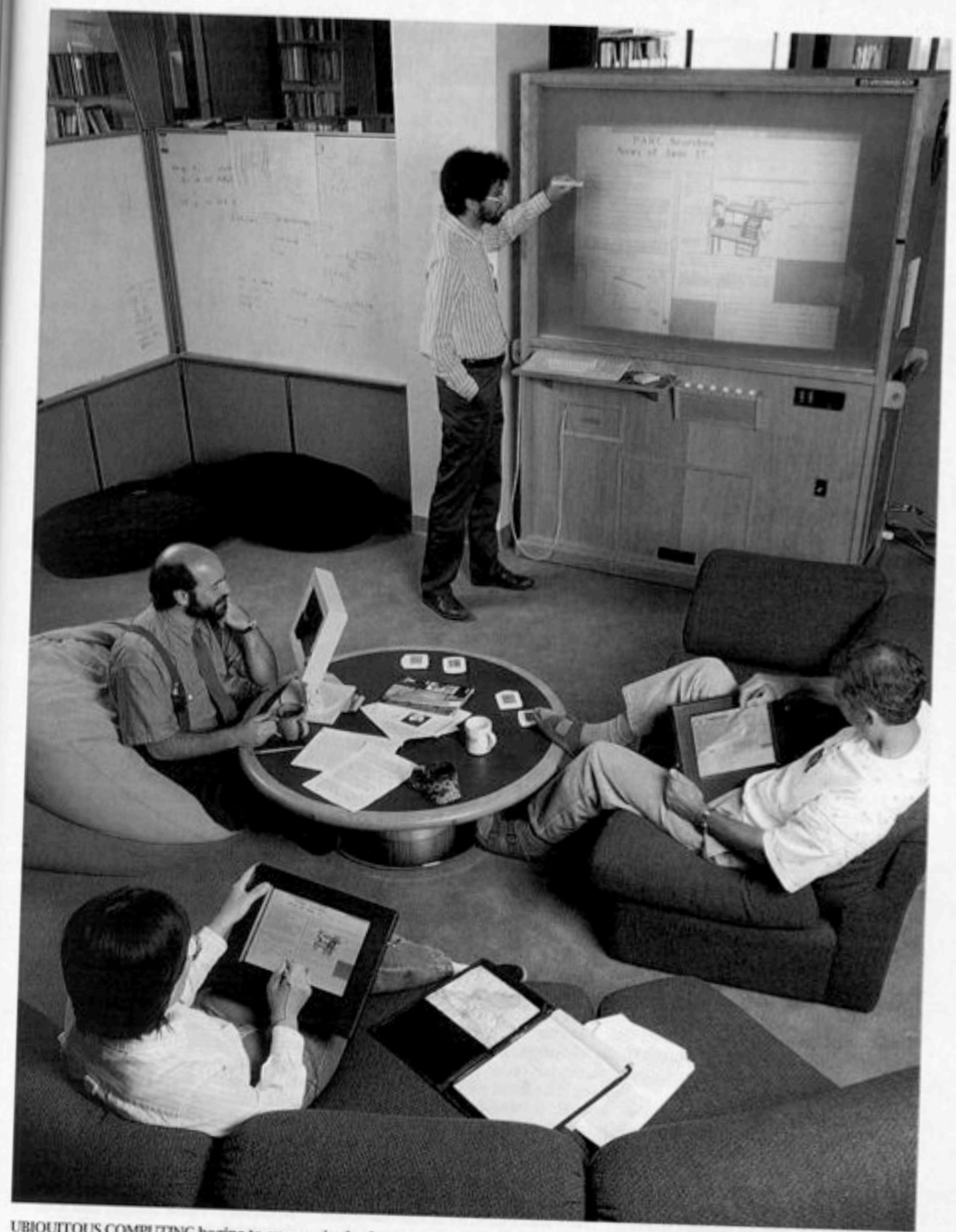

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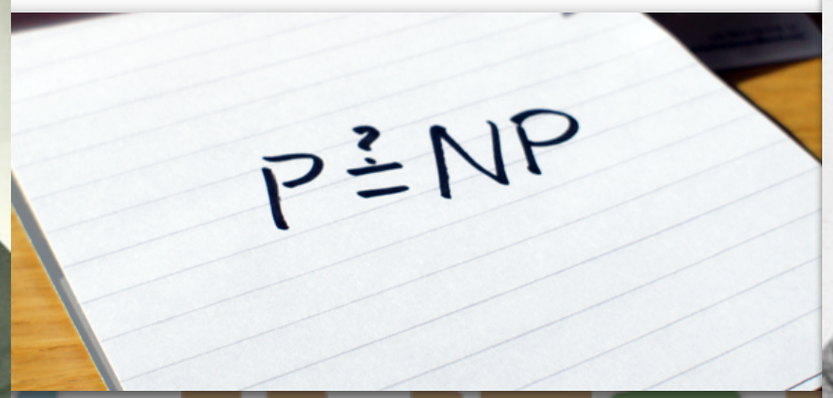
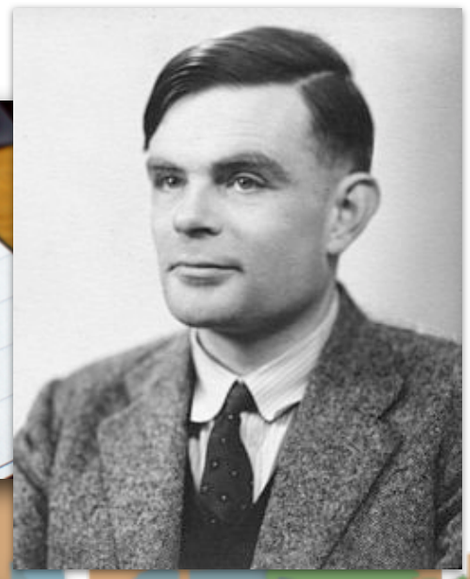
0 — 1 — 2 — 3

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/

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/

0 — 1 — 2 — 3

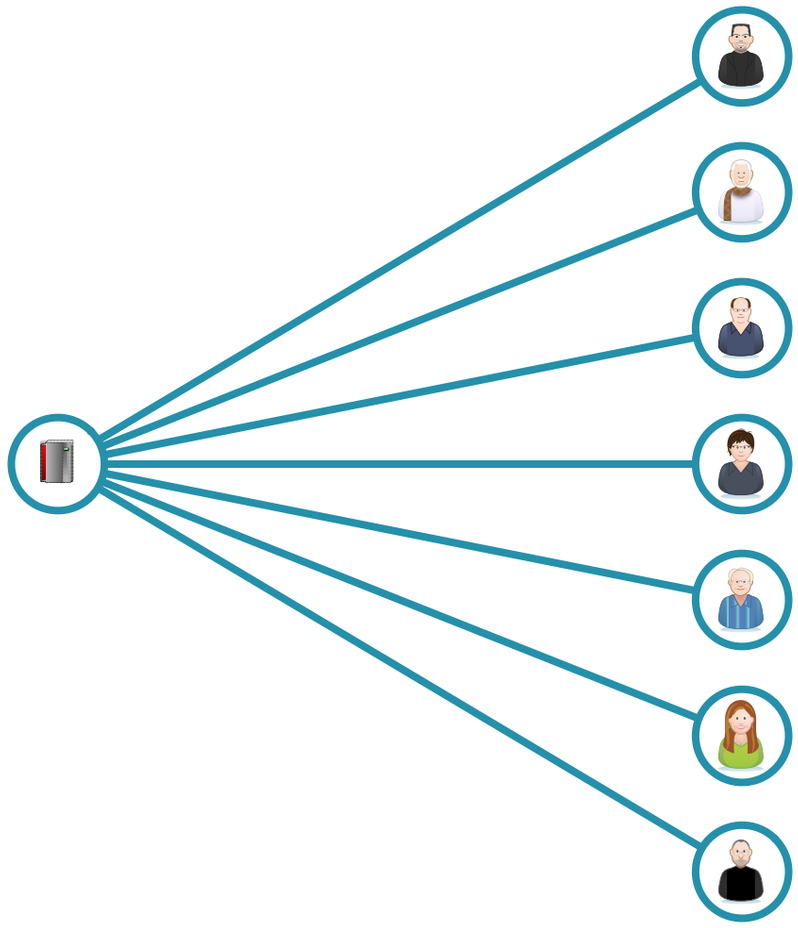
Third Wave

- 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

First Wave



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Second Wave

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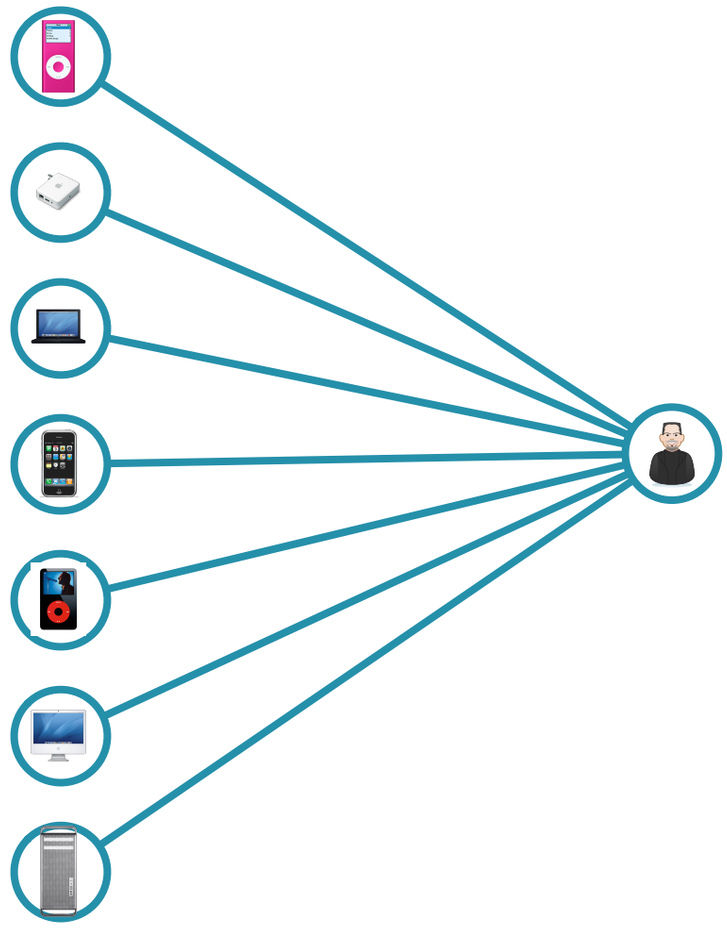
Third Wave



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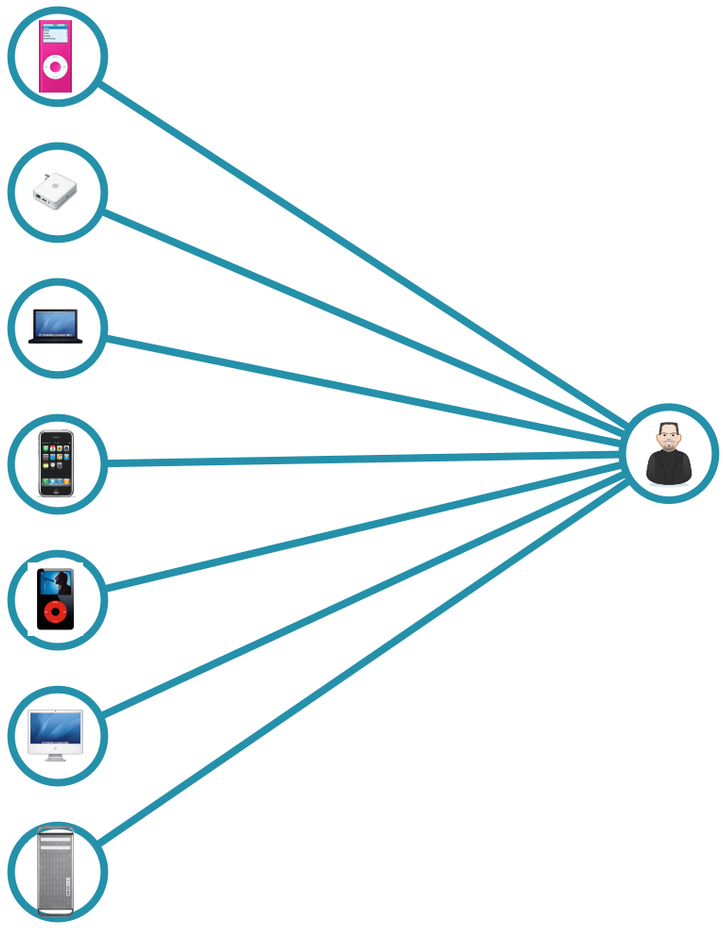
Third Wave



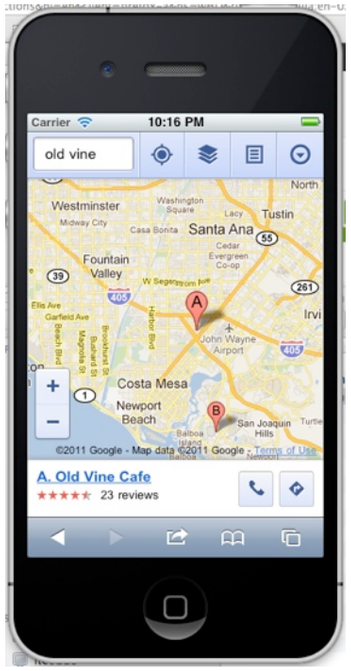
How are we going to manage all of these devices?

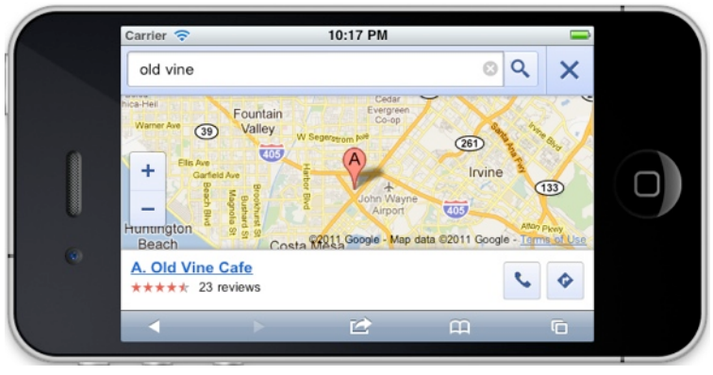
: Ubicomp is about people's relationship to computers

Ubicomp — Augmented Reality — Virtual Reality

Virtual Worlds

Mirror Worlds





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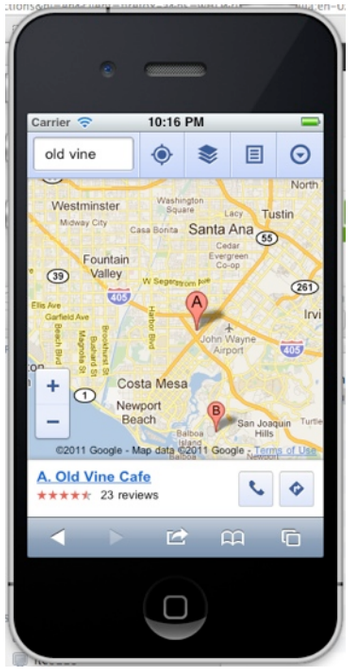

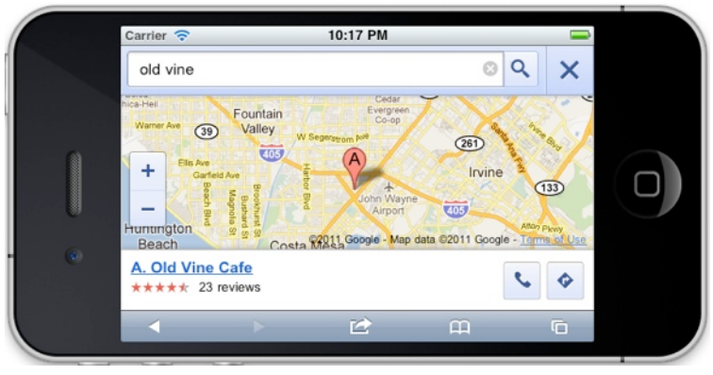

ar photo, vr photo, green photo

Ubicomp is about people's relationship to computers

- virtual reality
  - humans enter the computers world

- ubiquitous computing
  - computers enter the human's world

Who is going to manage all of these devices?

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

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!

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}

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Why now? What has changed?

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

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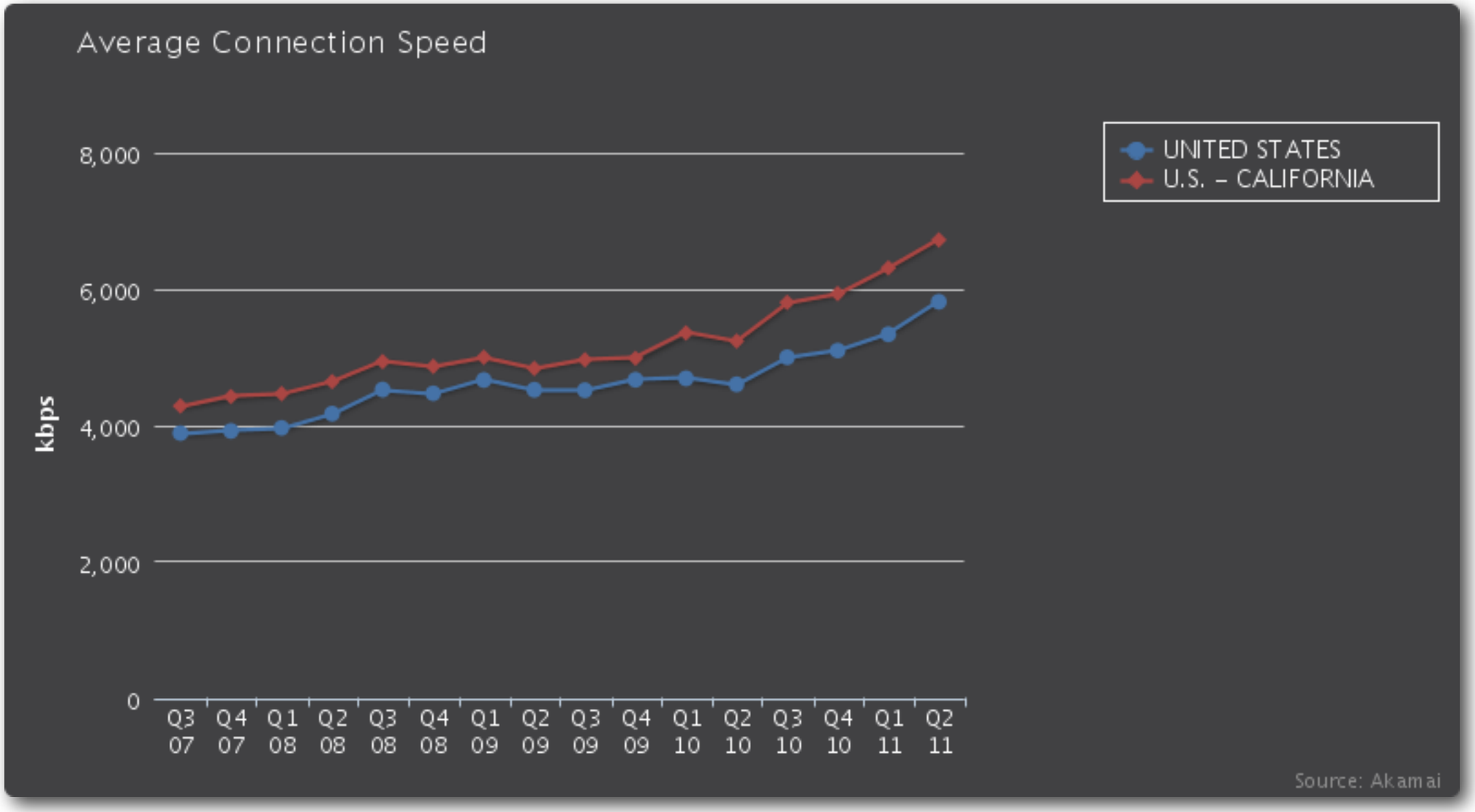
Connectivity



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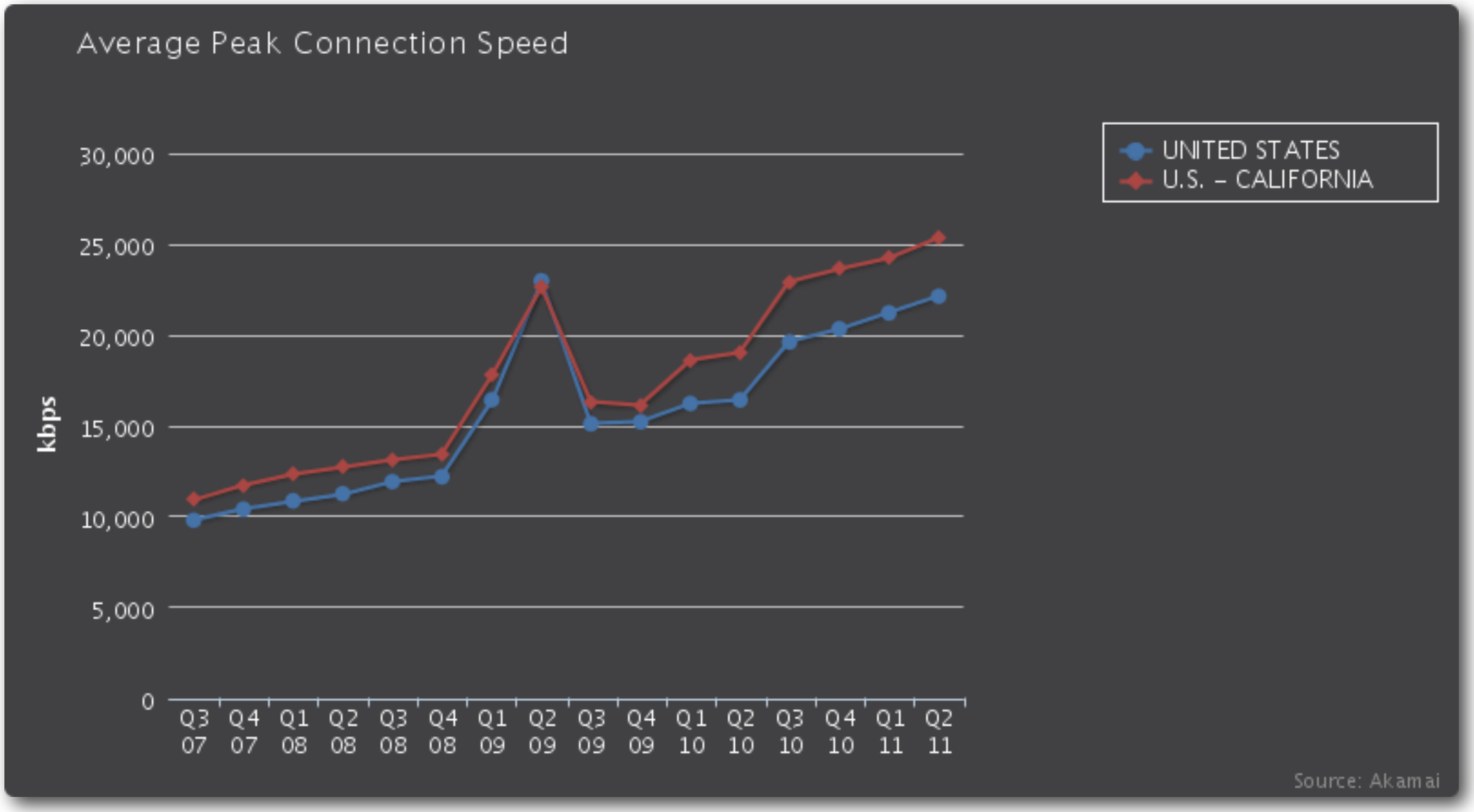

Connectivity

Which country has the fastest mobile broadband?

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Greece

(5.3 mbps average)

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Austria

(23.4 mbps highest average peak connection speed)

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"average connection speeds increased by more than 100% year-over-year at 22 mobile providers"

-akamai

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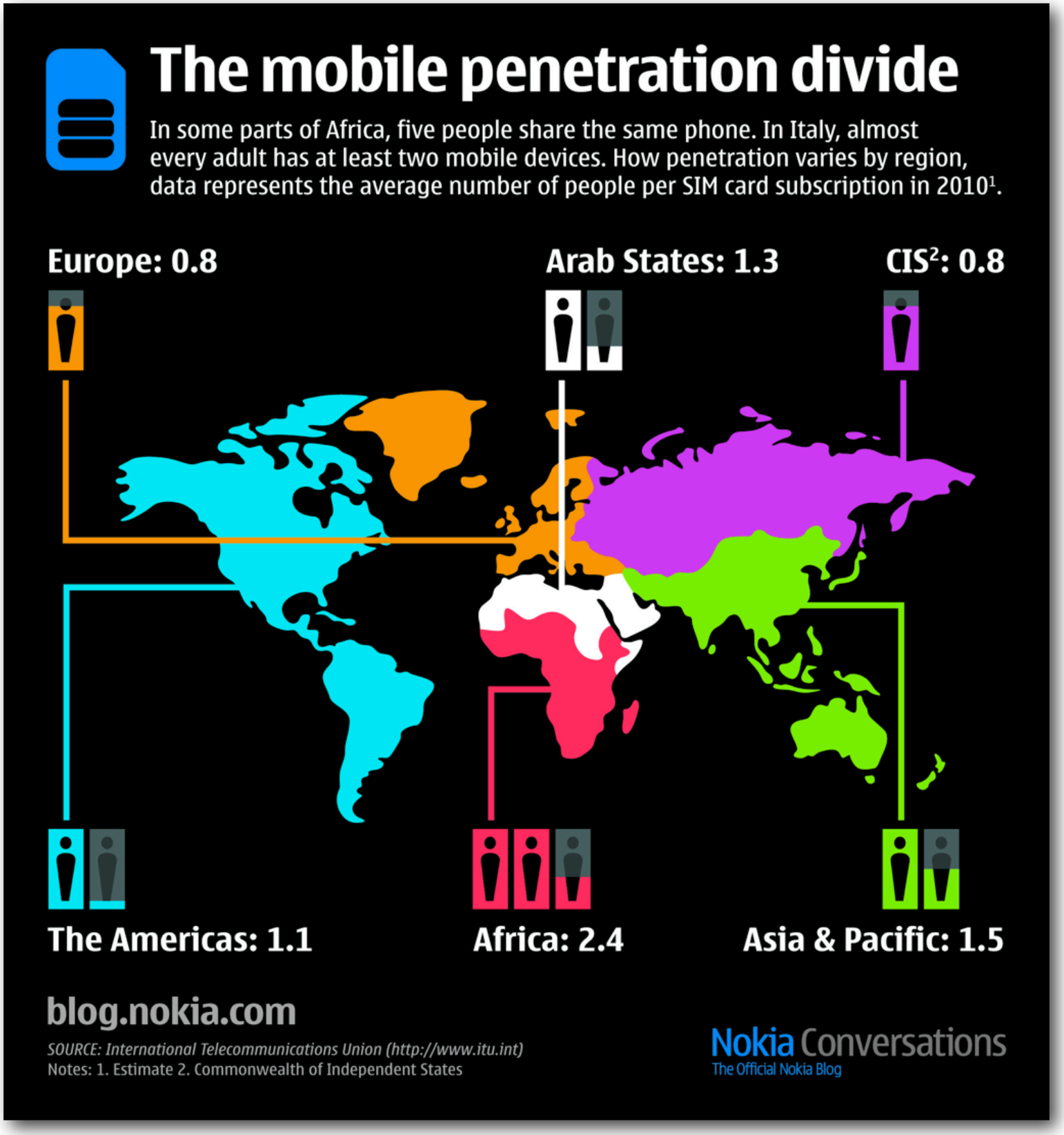
Smart Phones



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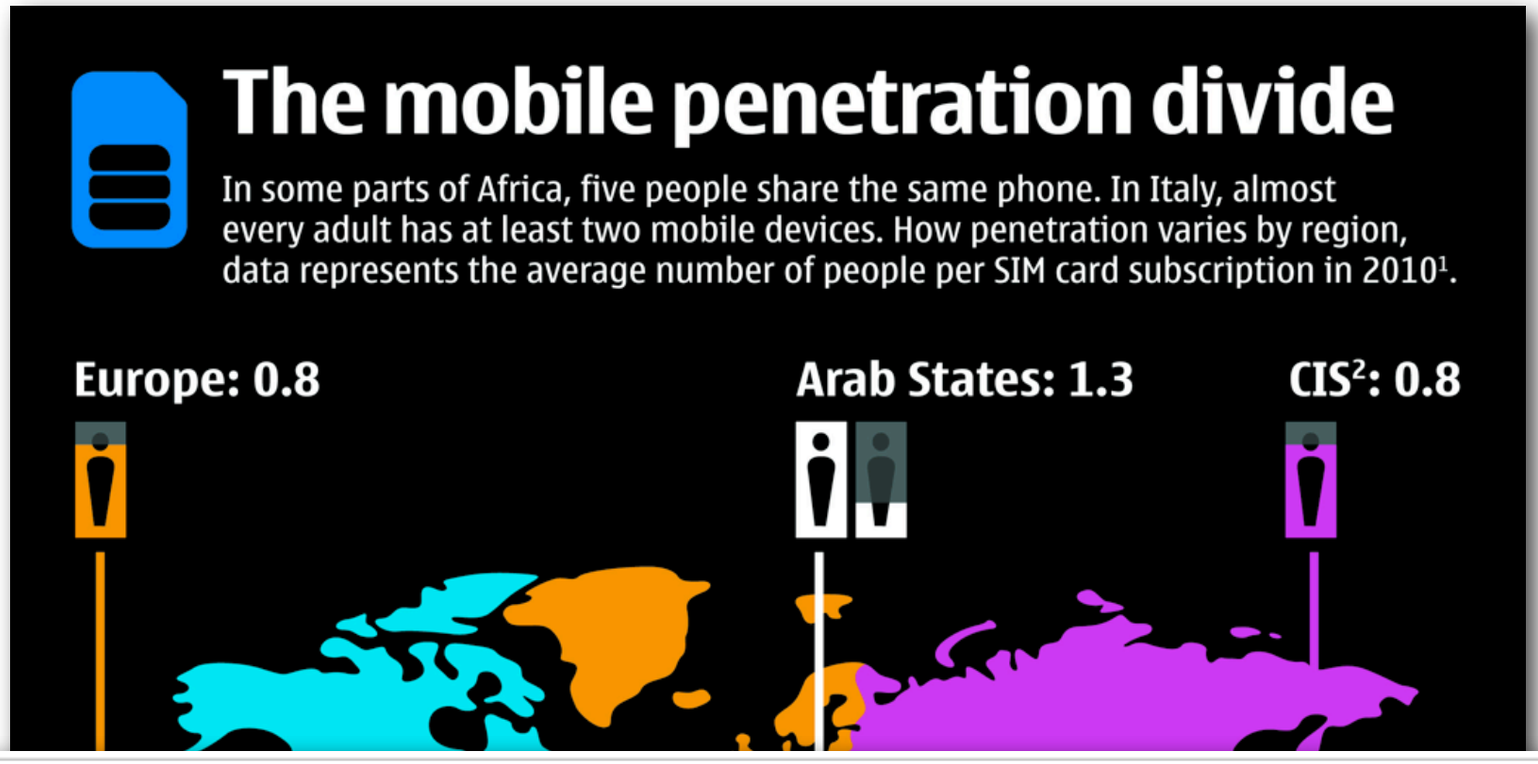

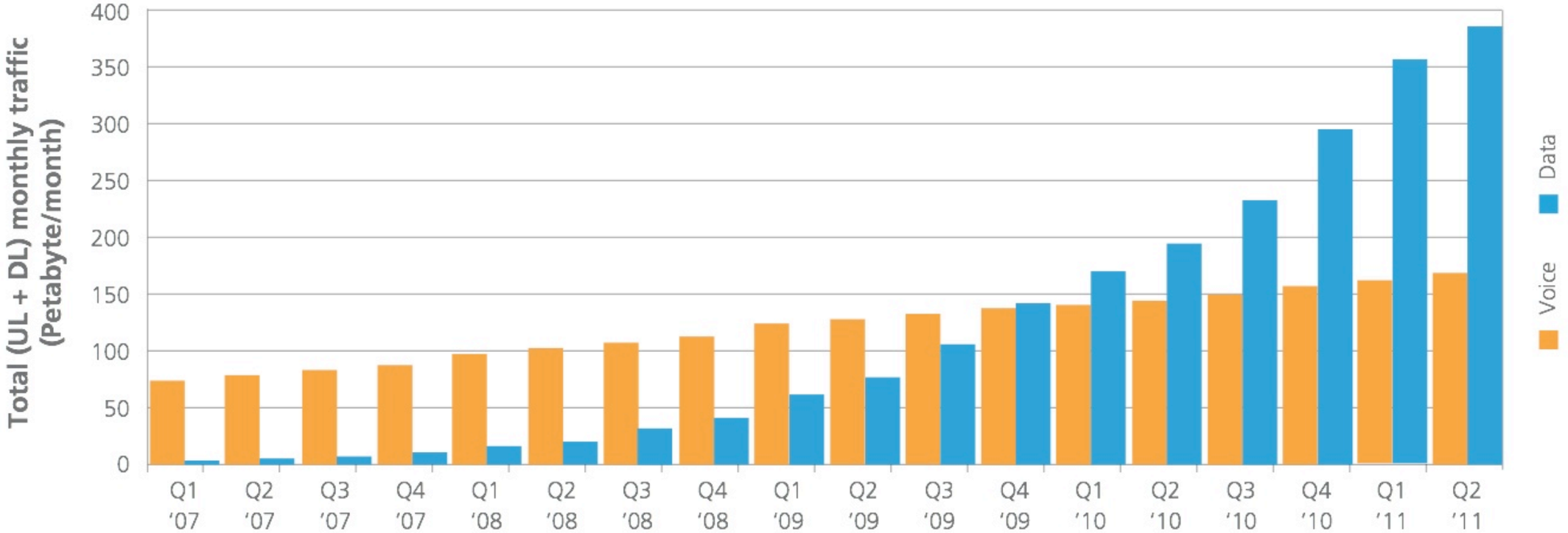

Figure 40: Total Monthly Mobile Voice and Data as Measured by Ericsson [Source: Ericsson]

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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

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Security Threats

- 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

Security Threats

China, U.S., Israel

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Anonymous, LulzSec

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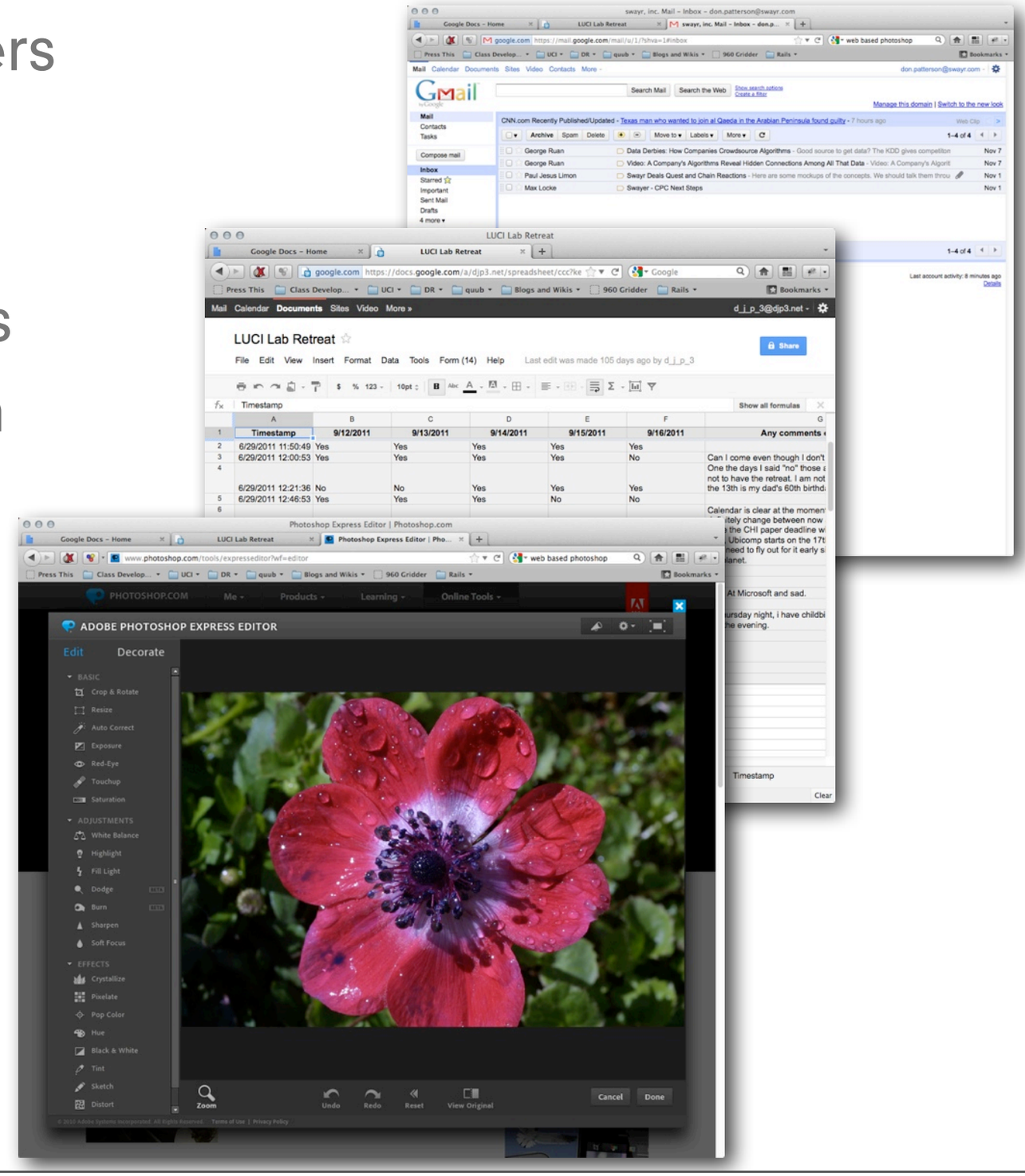
Sentient browser applications

- 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



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So, now the landscape has changed

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So, now the landscape 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

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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

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- Sentient browser applications

It is very cheap to run powerful computers in consolidated data centers

So, now the landscape has changed

Why now? What has changed?

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

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?

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

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

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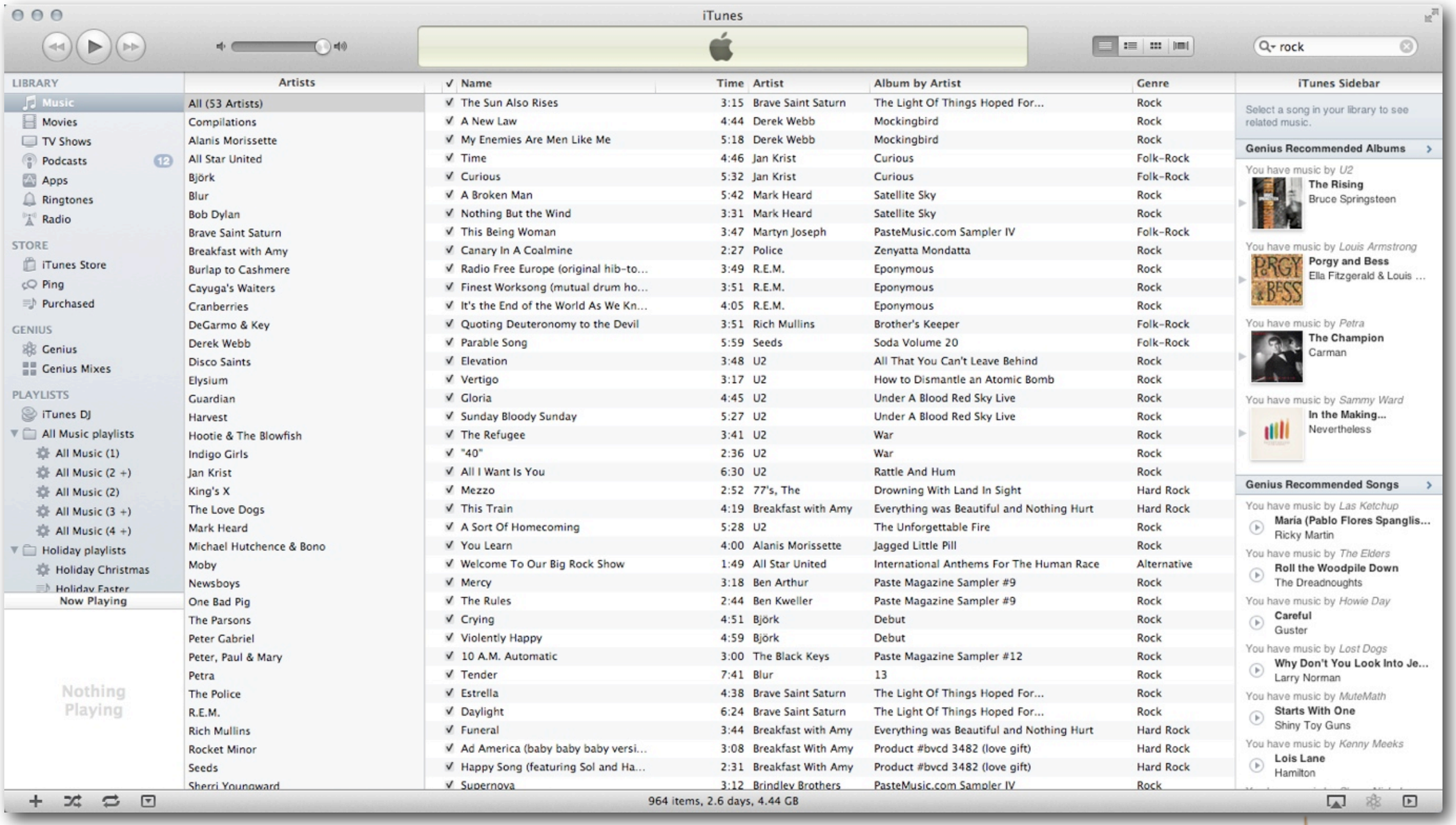
amazon web services™

heroku

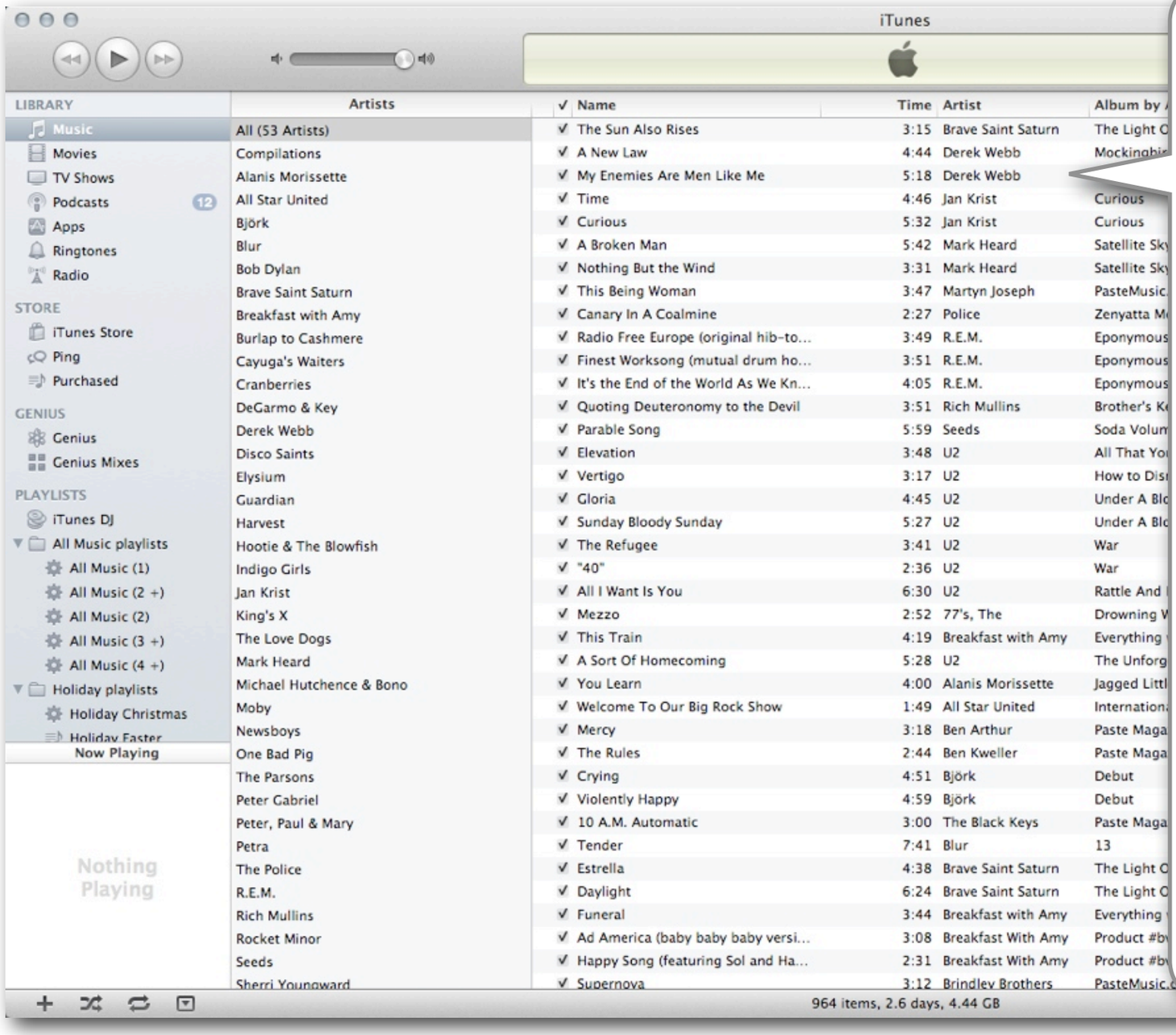
rackspace HOSTING

linode.com

Consumer vision : iTunes Match



Consumer vision : iTunes Match



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

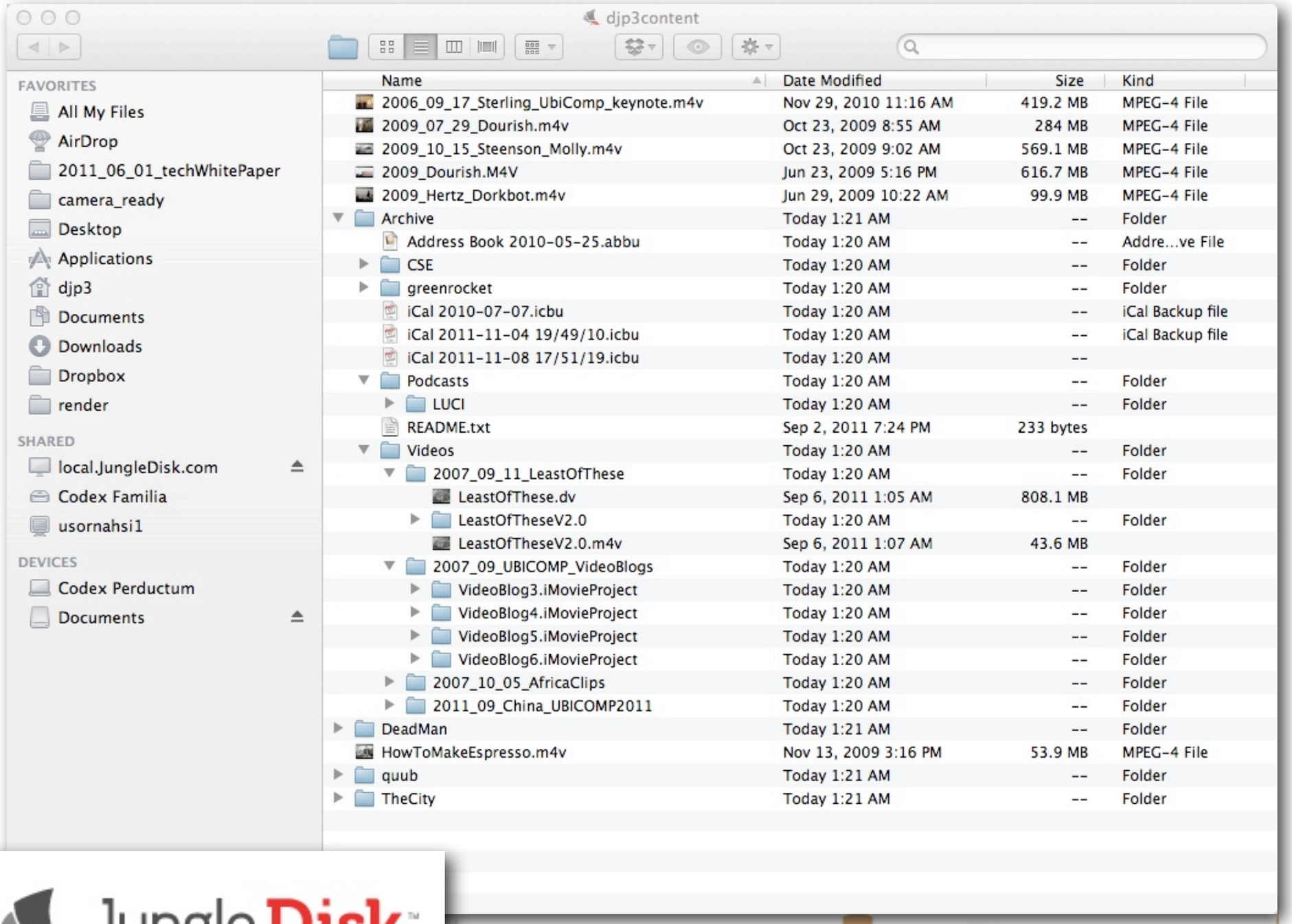
Consumers don't know how it gets there.

(It is all backed by an Apple data center)

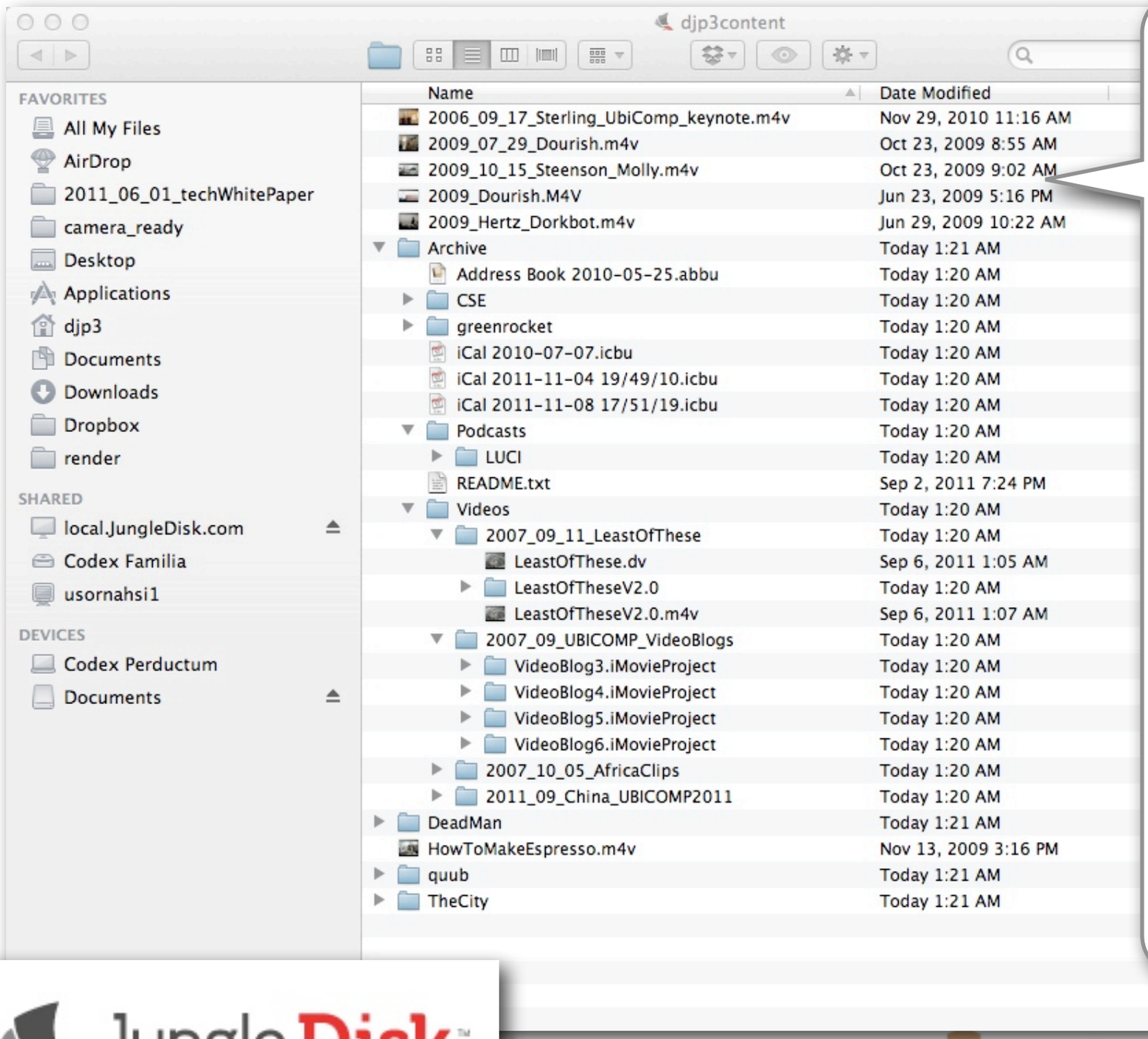
And now that it is in the cloud there is no more syncing, no more worrying about disk space, no more worrying about back ups.

$25.00 a year

Consumer vision : JungleDisk



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

Jungle Disk™

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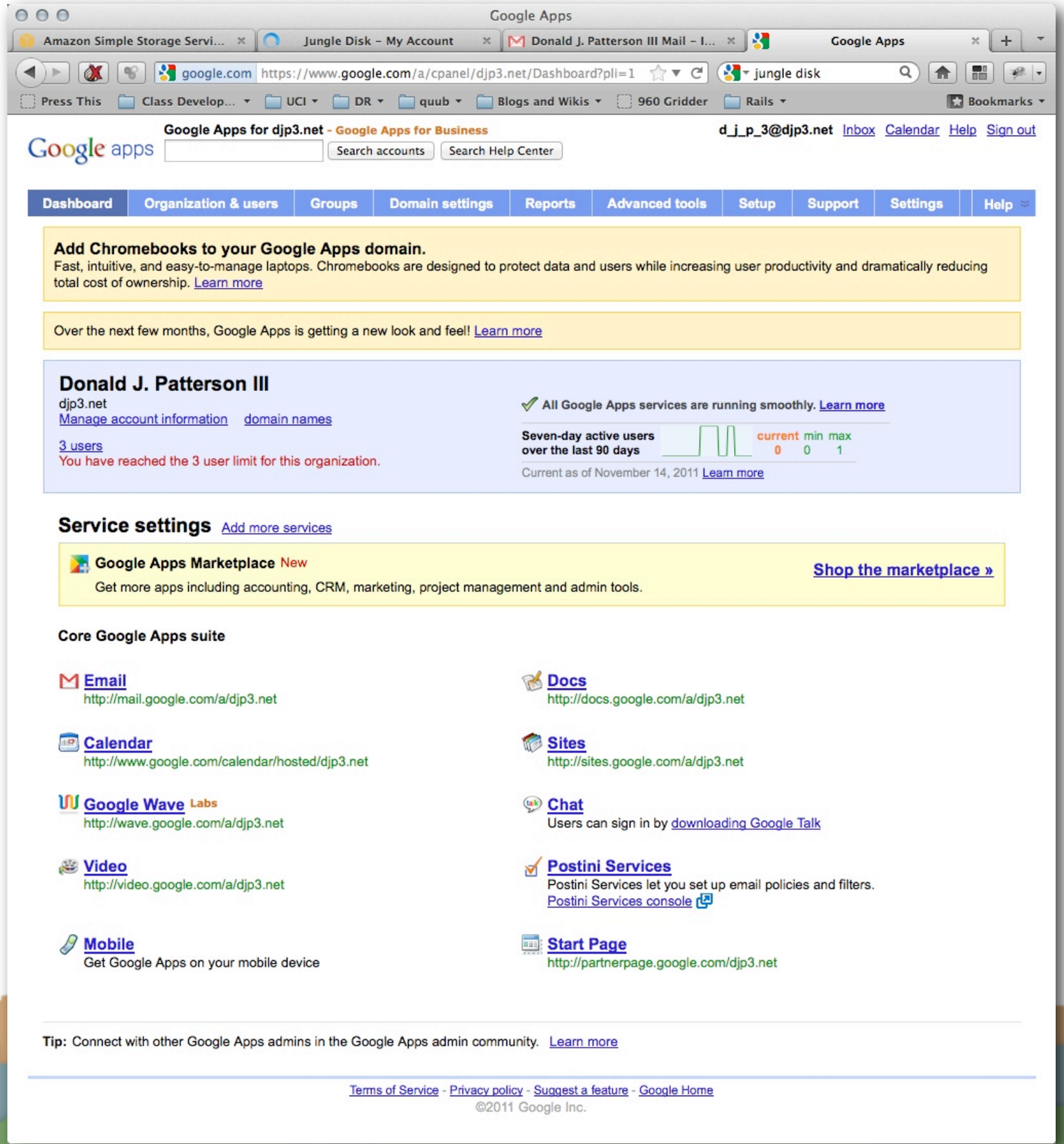
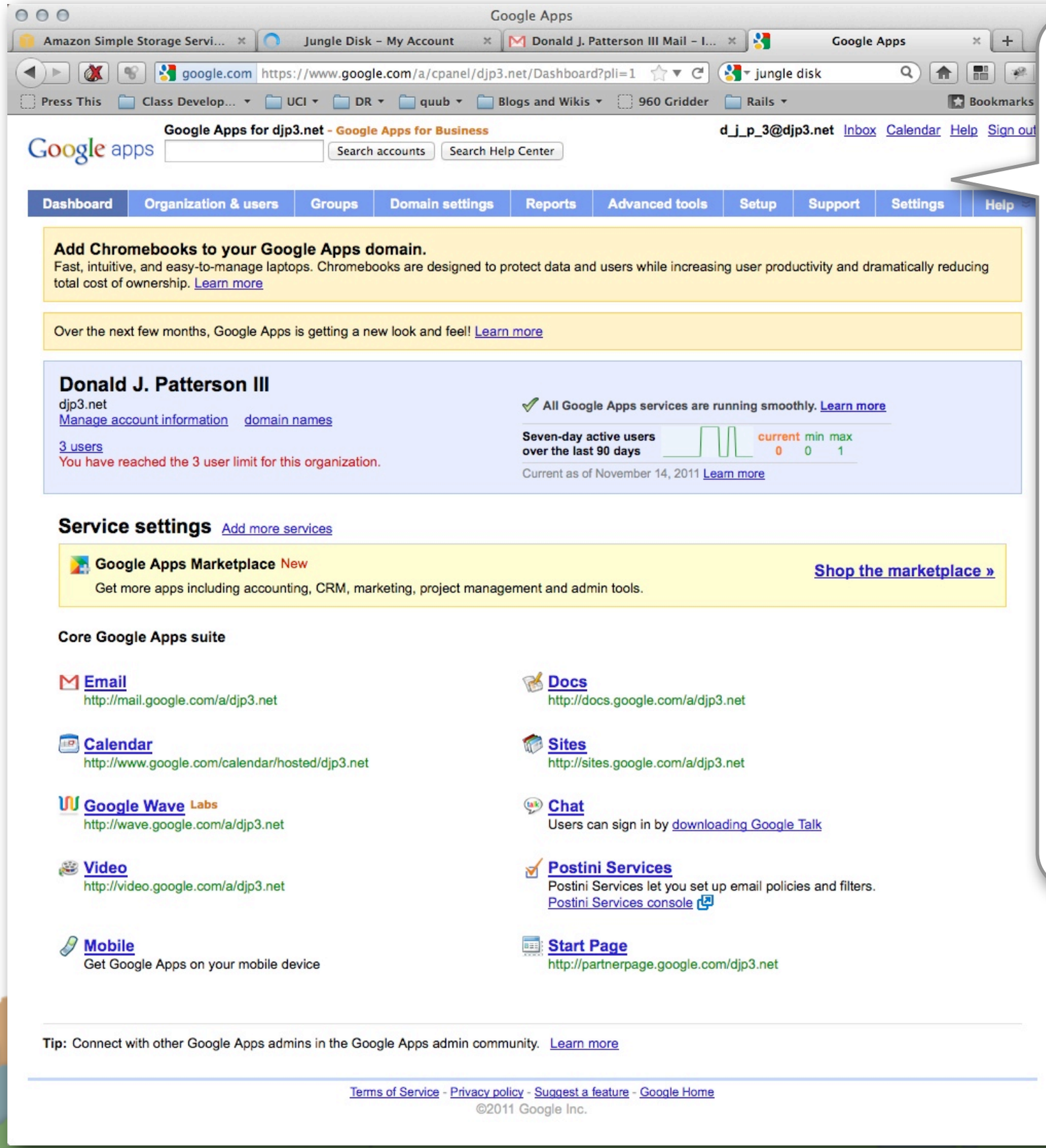
Services vision : Google Apps



Services vision : Google Apps



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

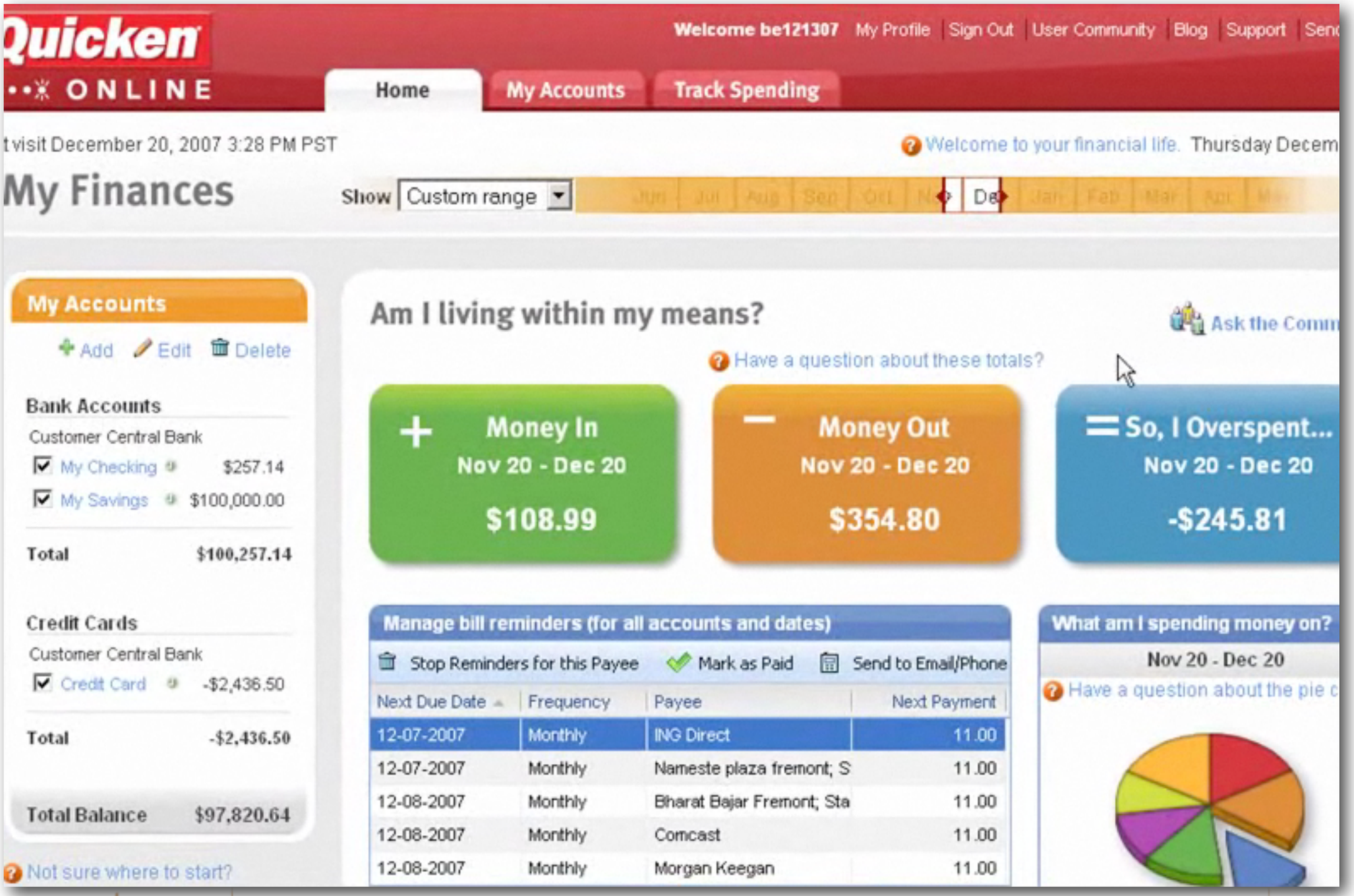
No limit on storage, no ads, no software updating, no security management, no downtime

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

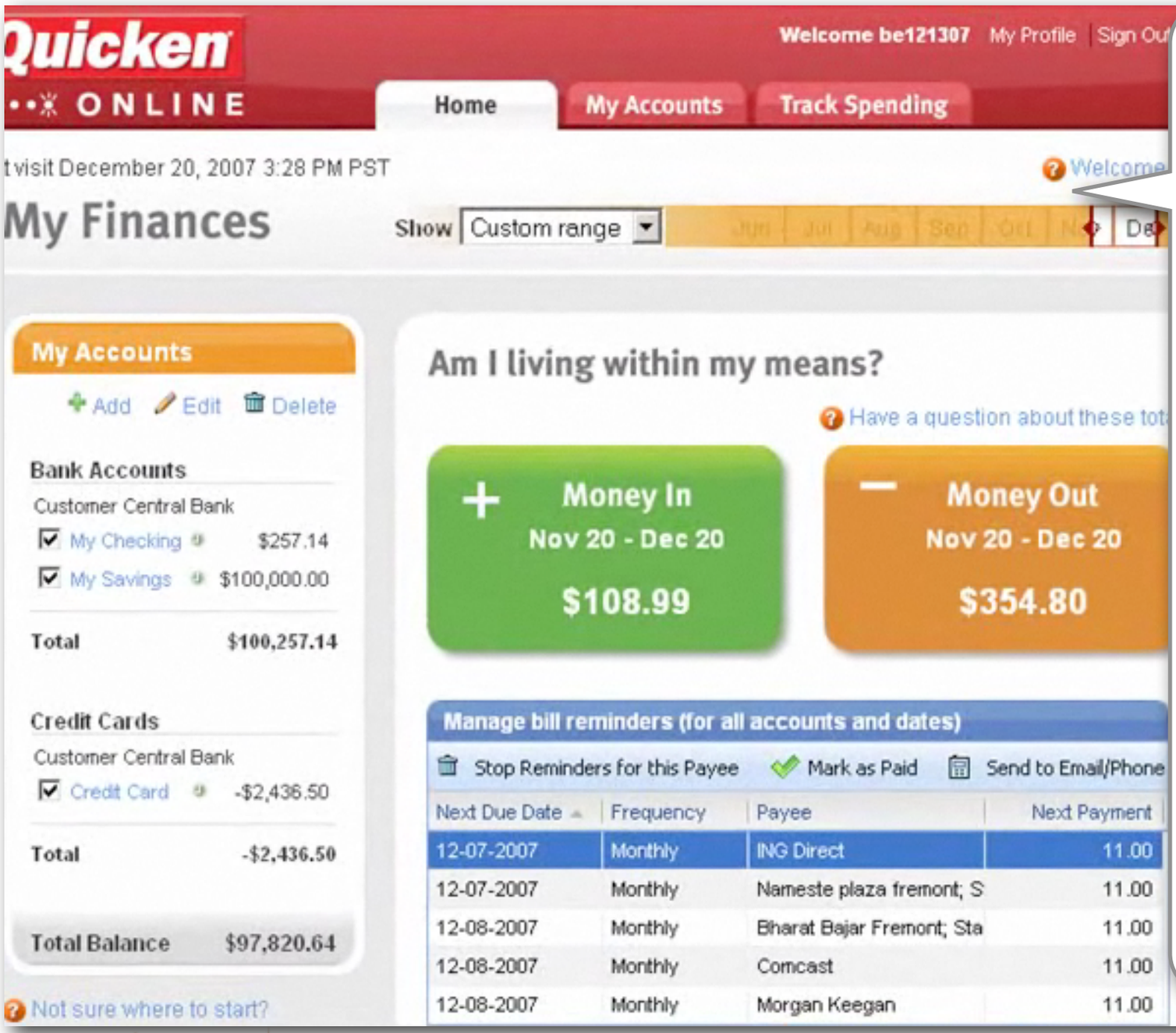
Always on, available from any browser

$50.00 per user/per year

Services vision : Quicken Online



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

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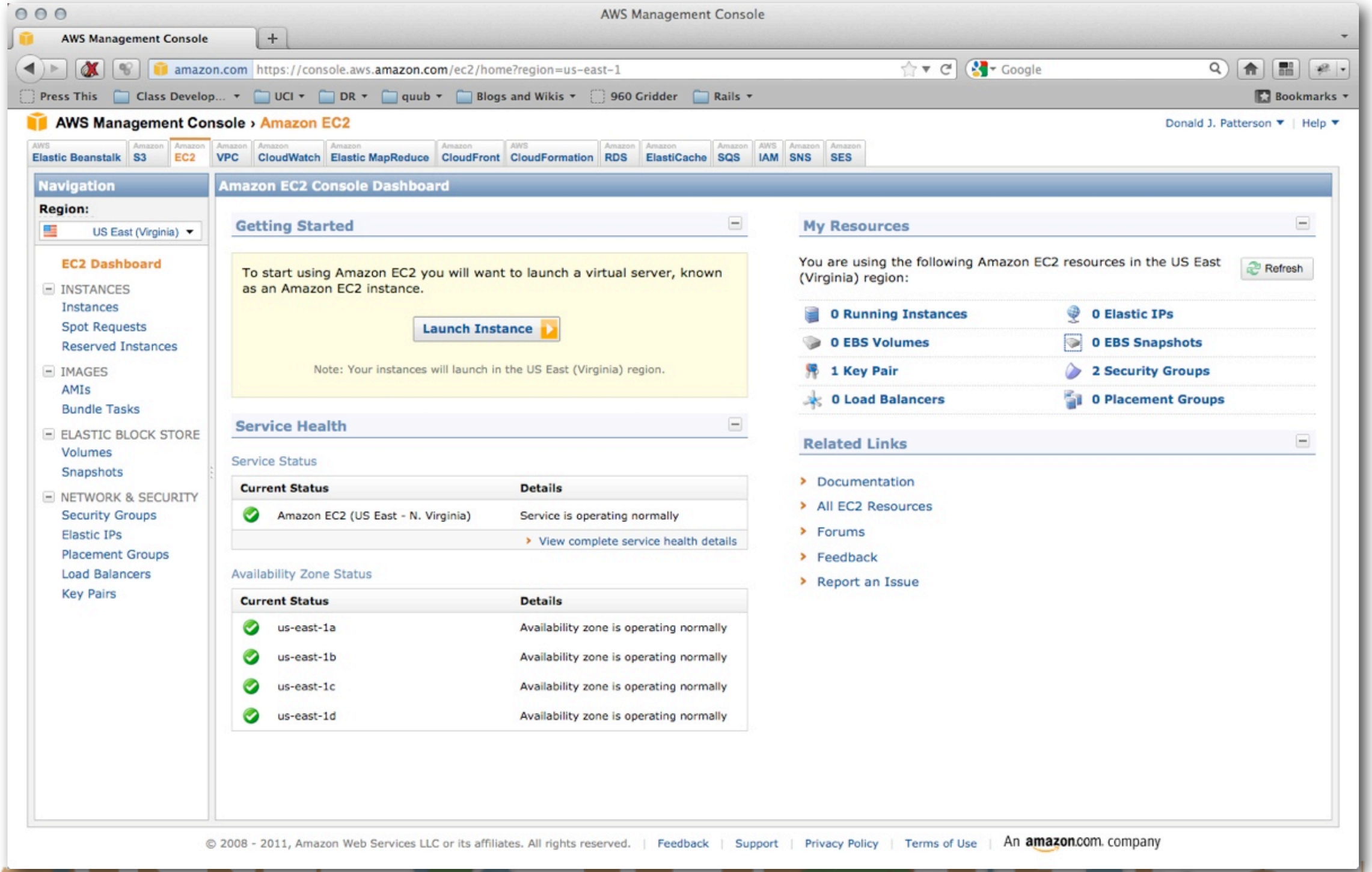
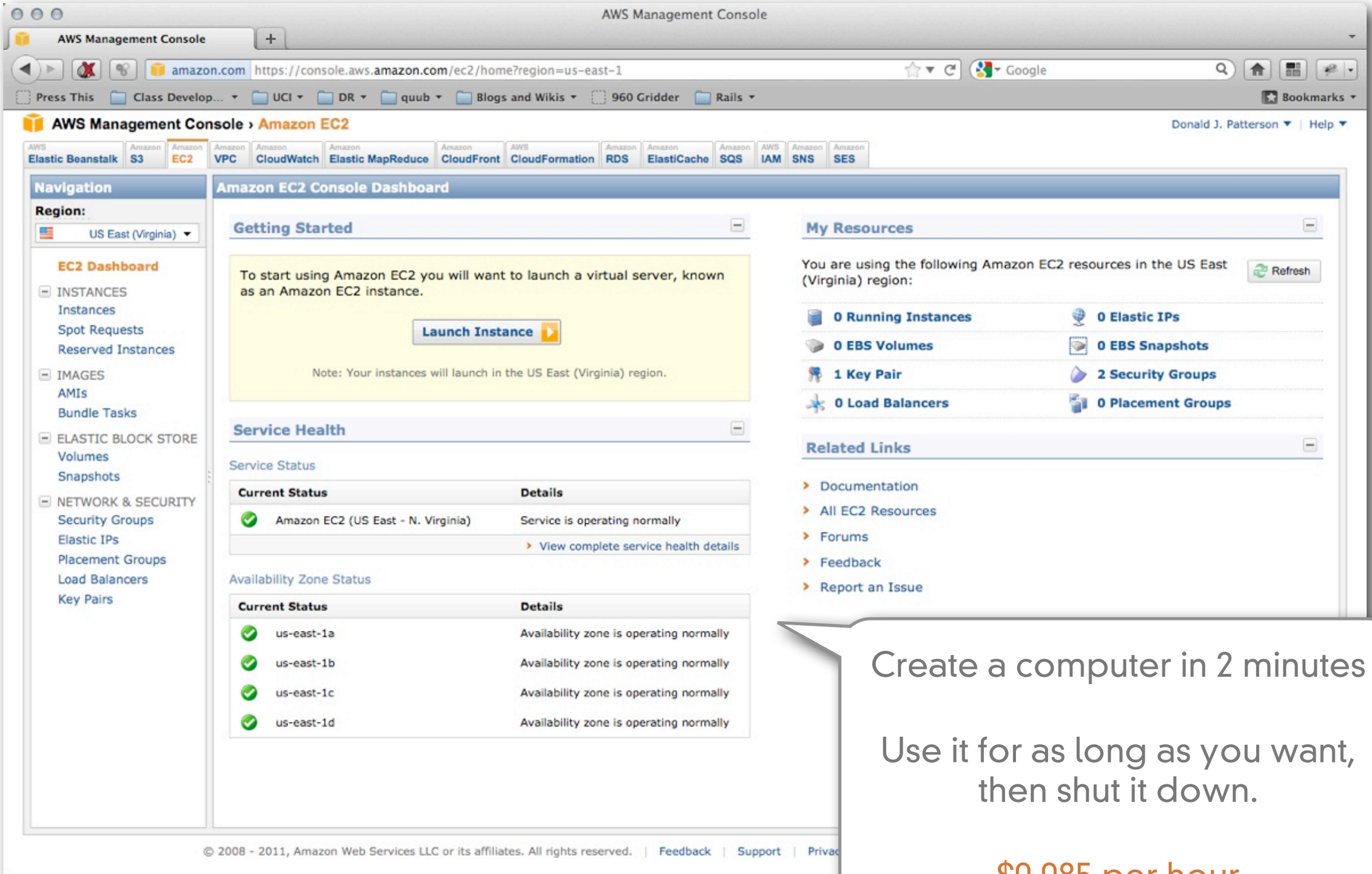
Infrastructure: Amazon web services



Infrastructure: Amazon web services

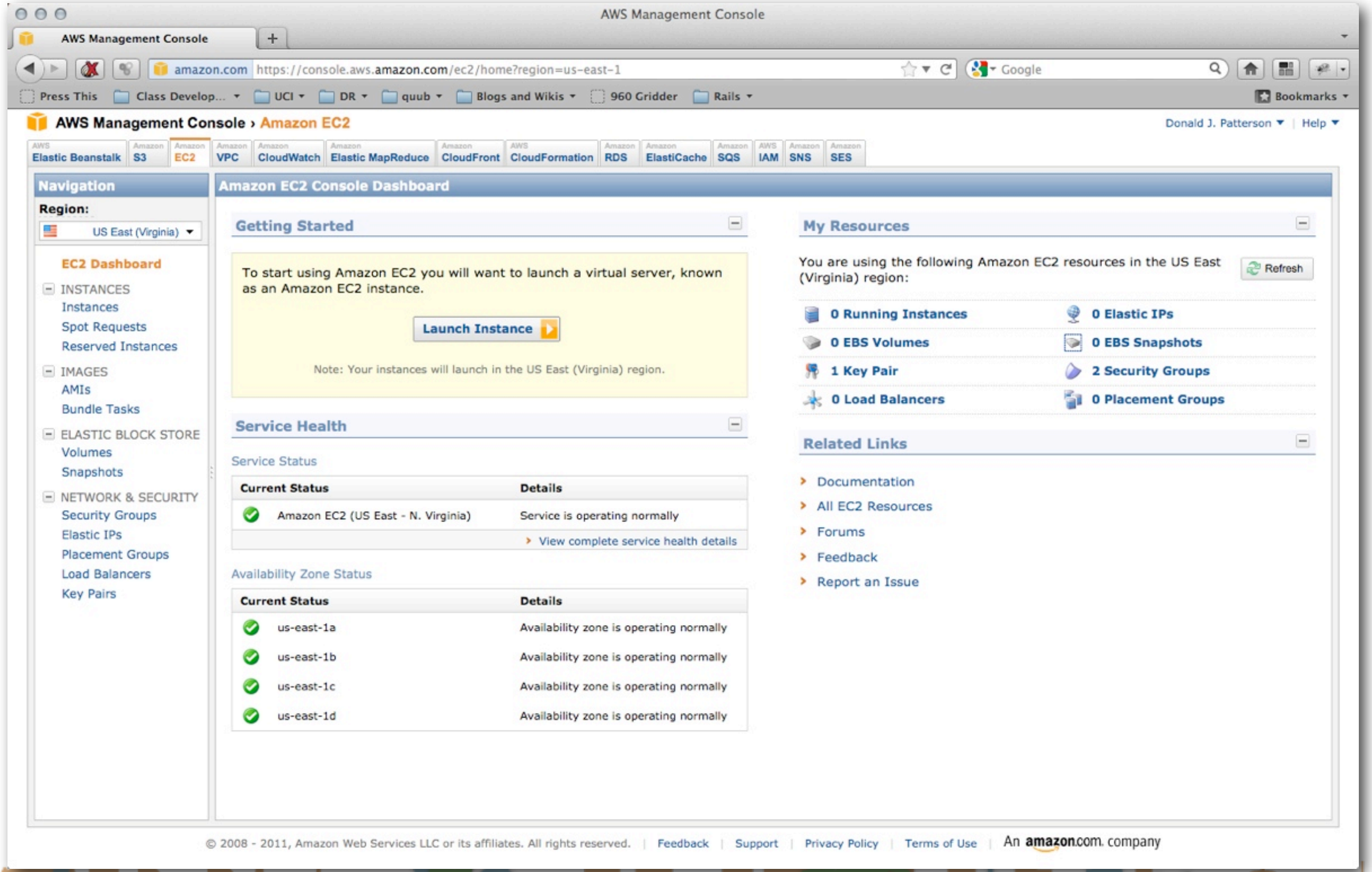


Create a computer in 2 minutes

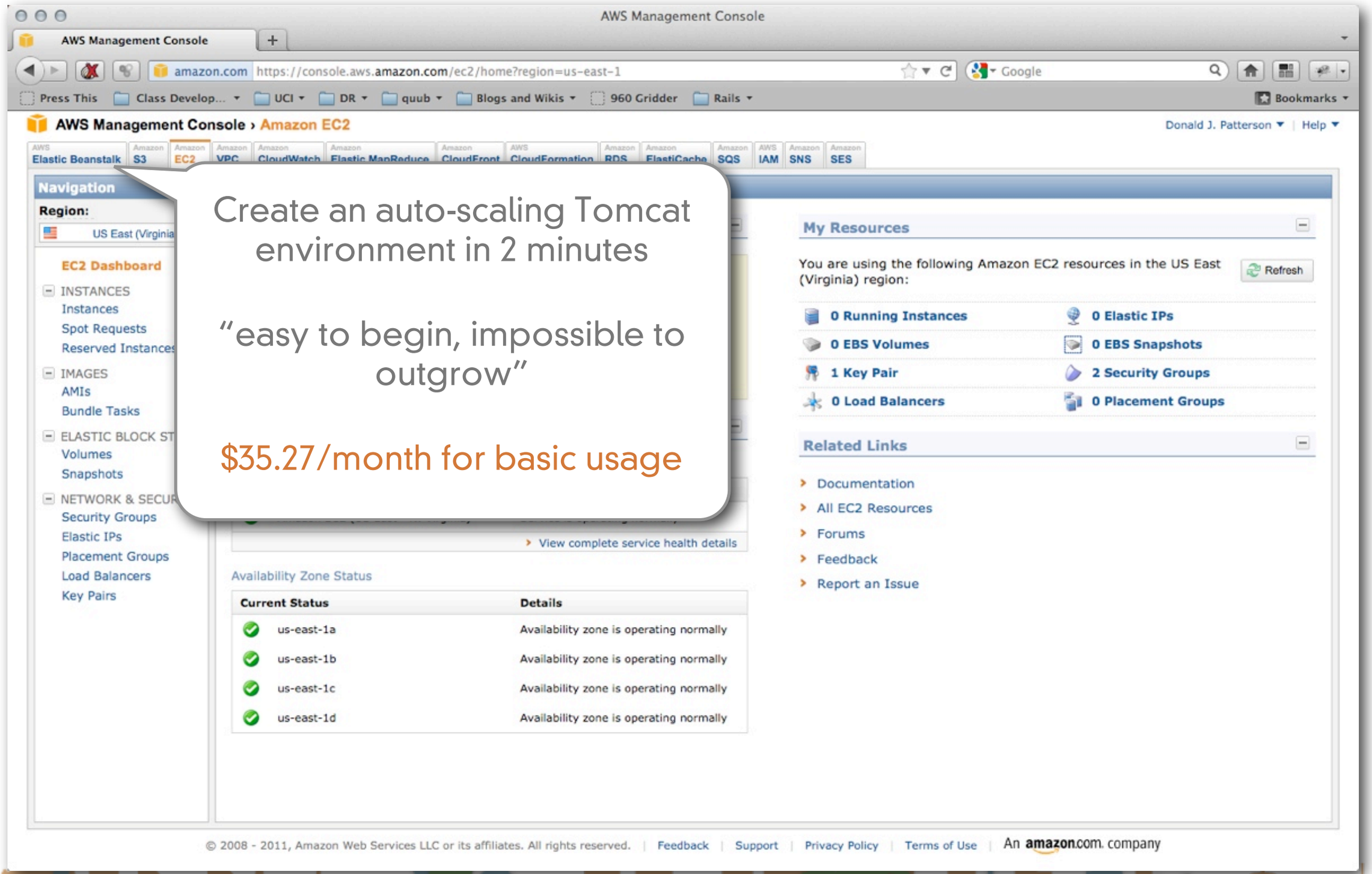
Use it for as long as you want, then shut it down.

$0.085 per hour
($744 per year)

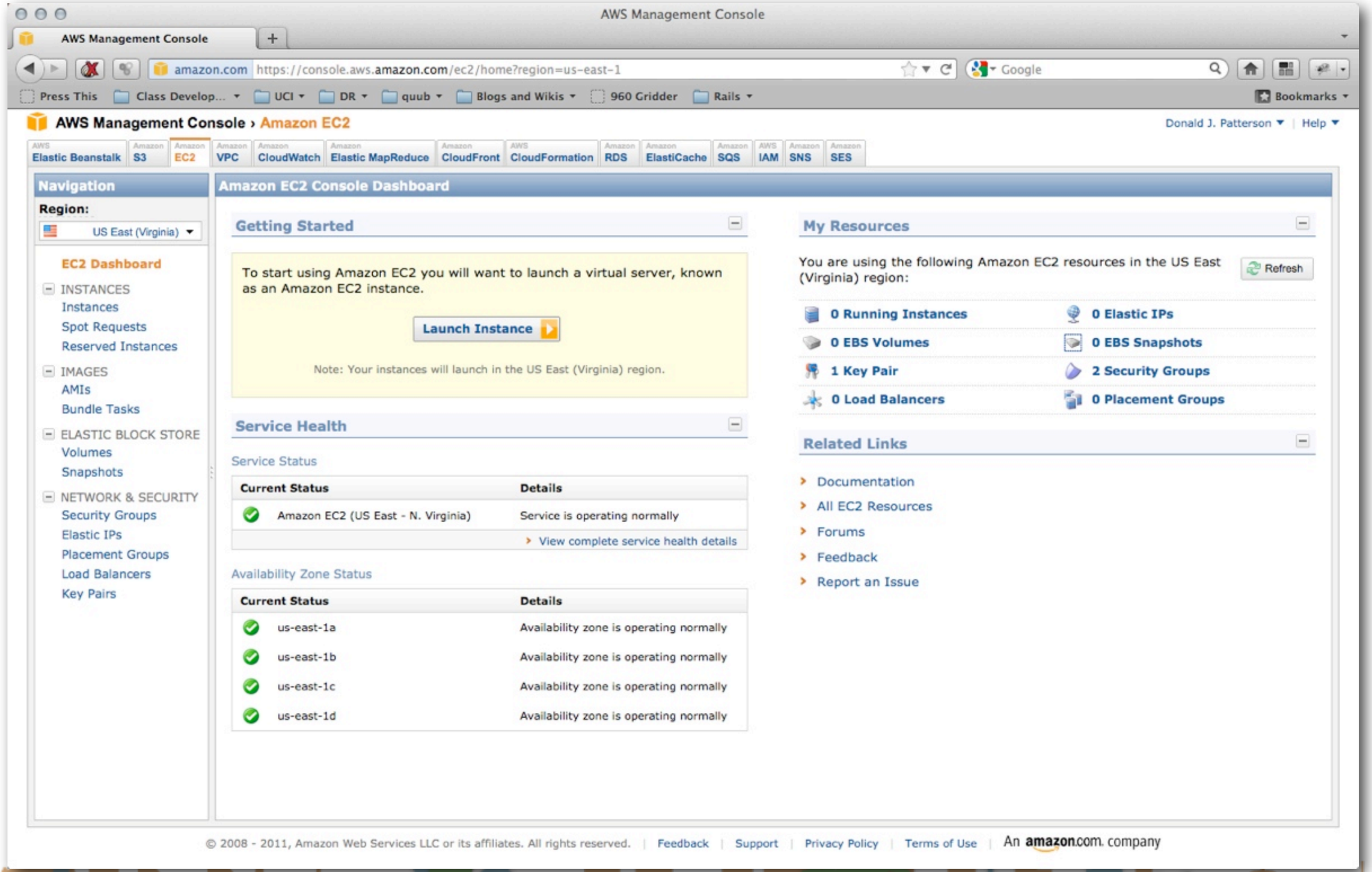
Infrastructure: Amazon web services



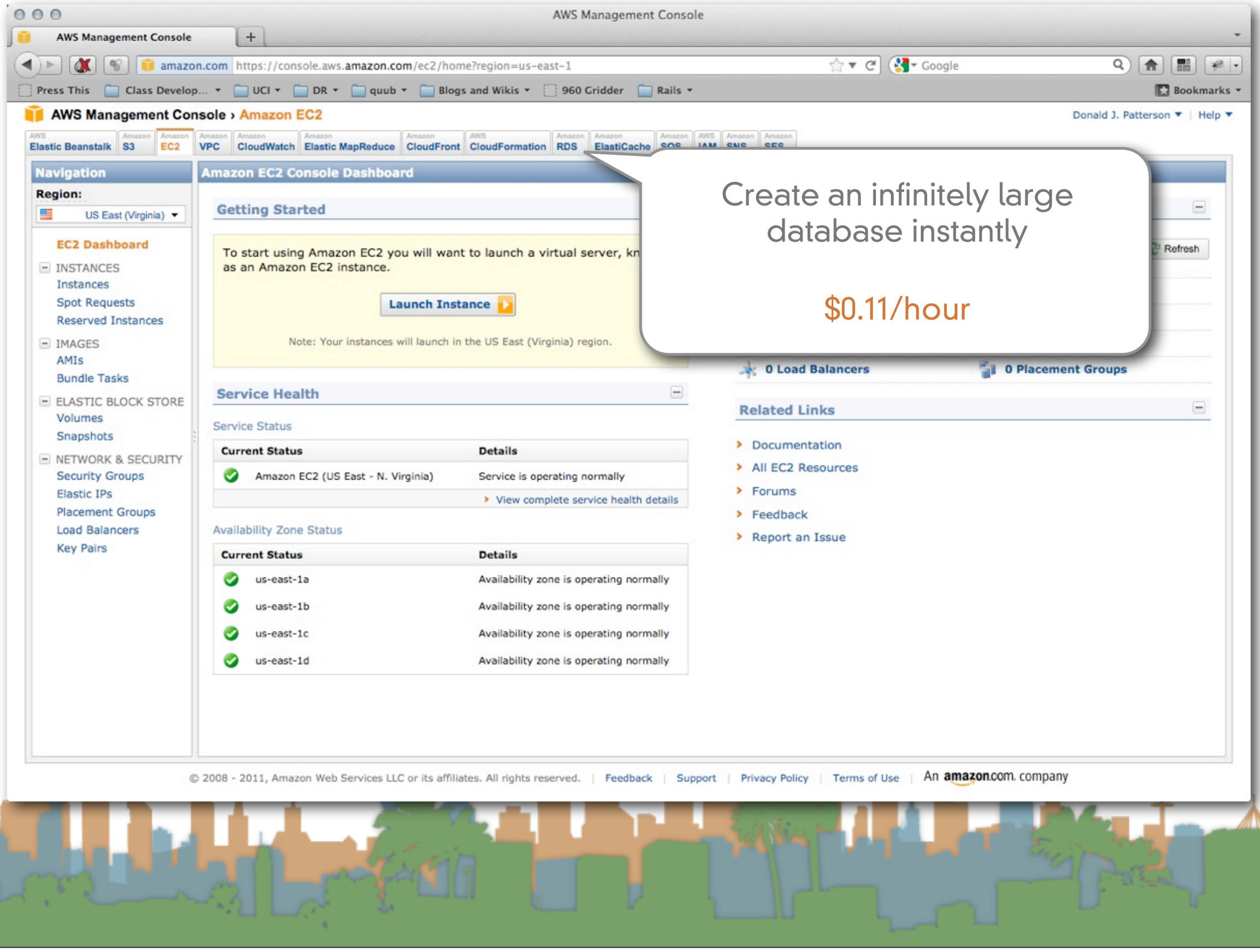
Infrastructure: Amazon web services



Infrastructure: Amazon web services



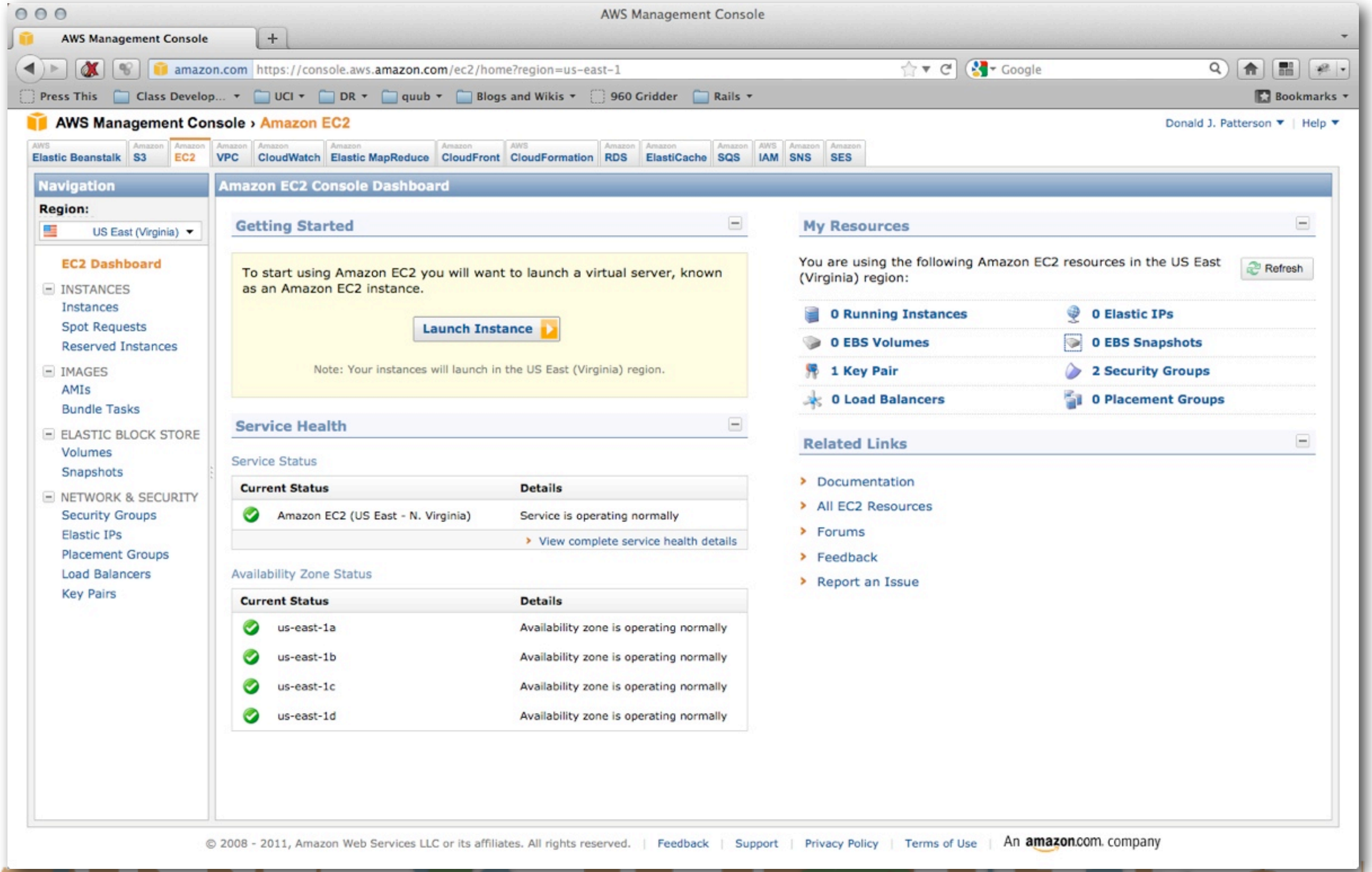
Infrastructure: Amazon web services



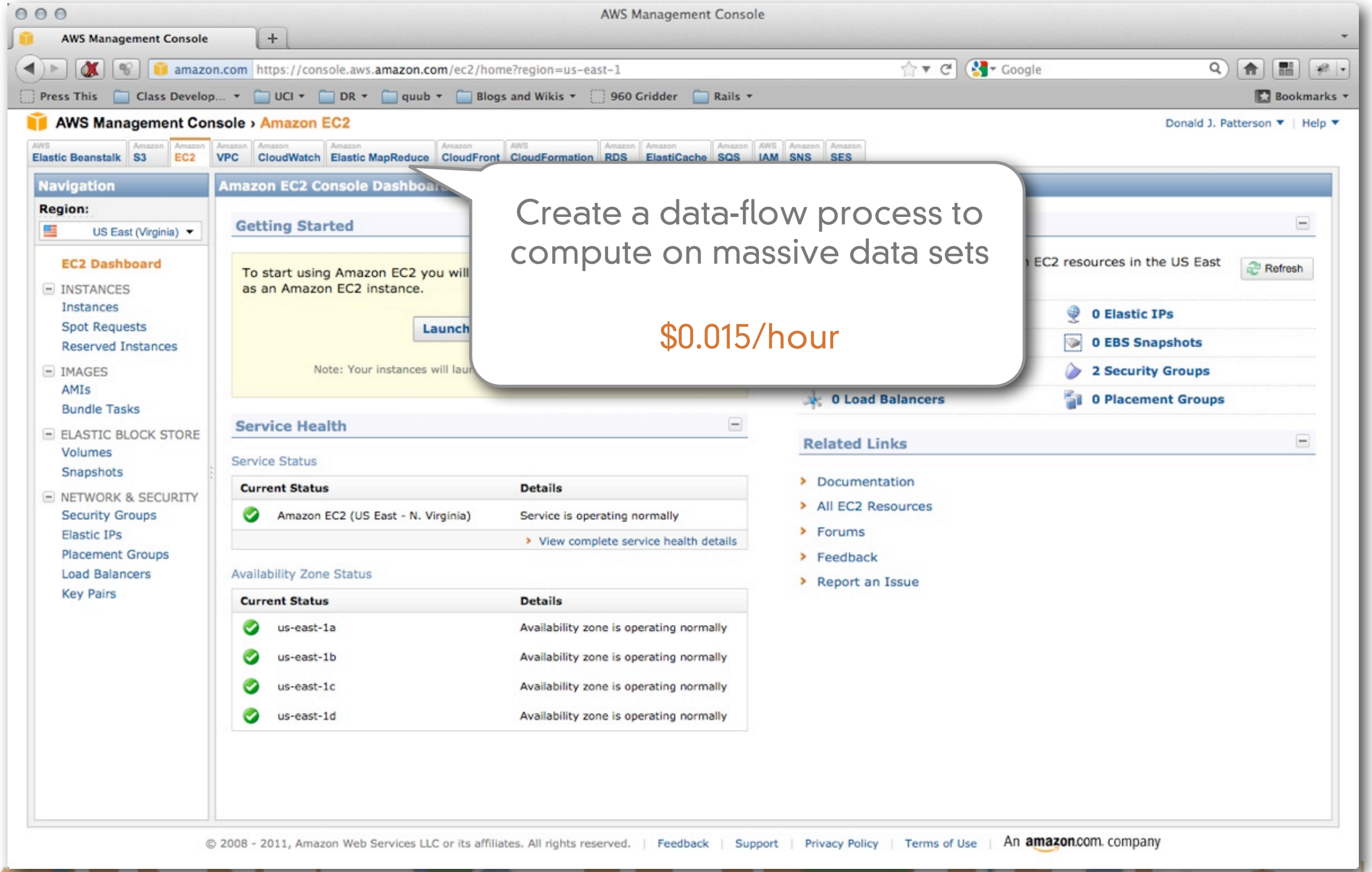
Create an infinitely large database instantly

$0.11/hour

Infrastructure: Amazon web services



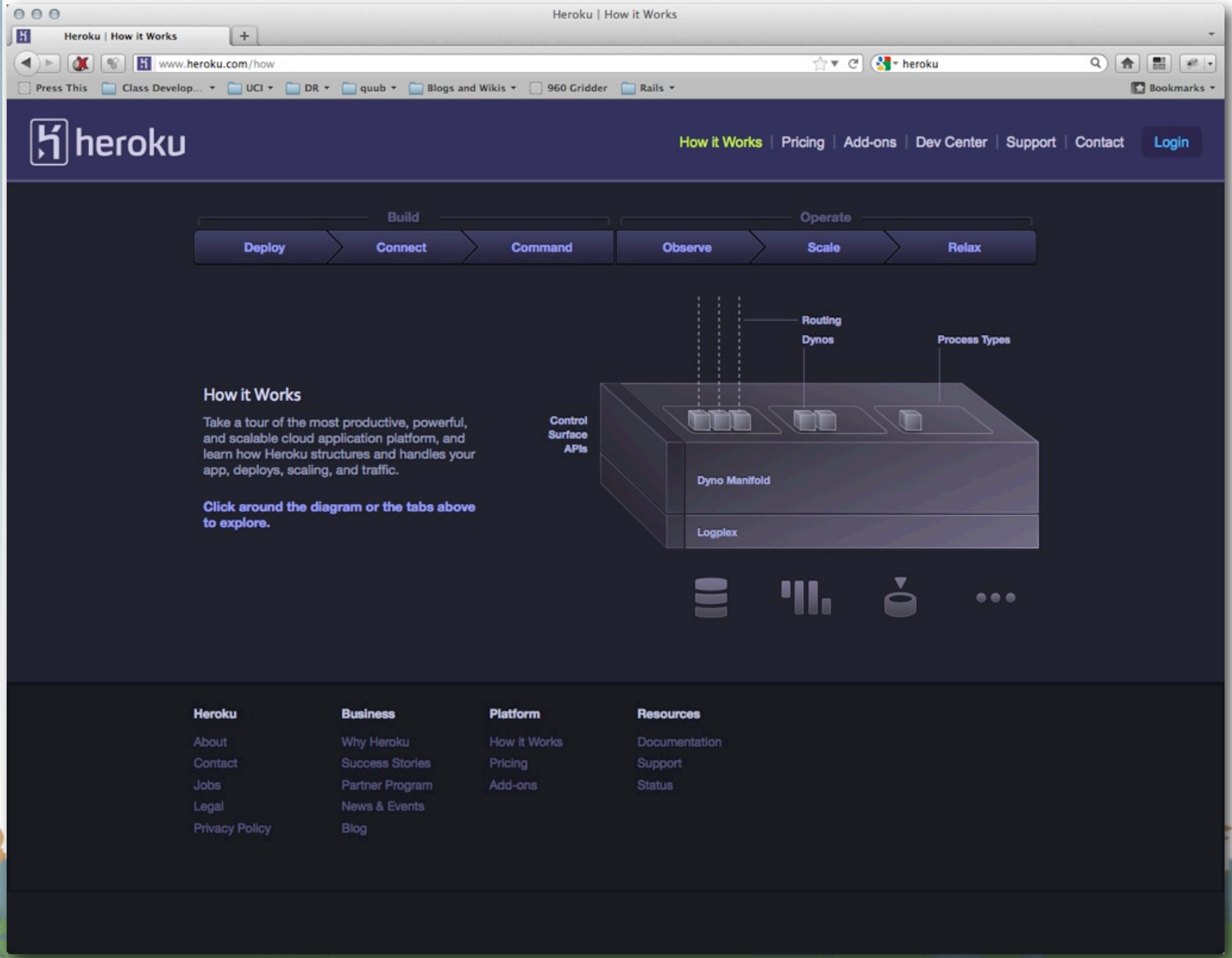
Infrastructure: Amazon web services



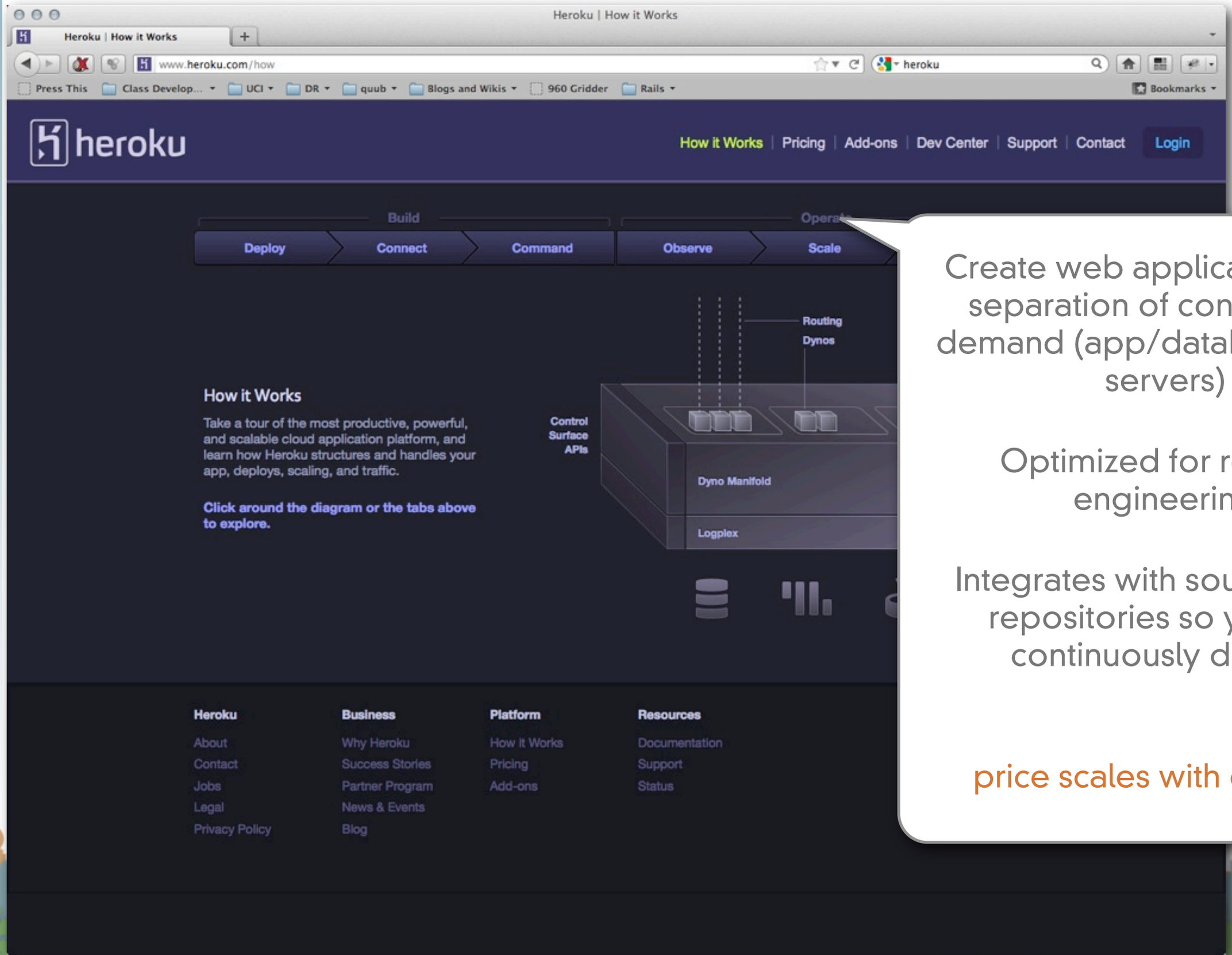
Create a data-flow process to compute on massive data sets

$0.015/hour

Infrastructure: Heroku platform services



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

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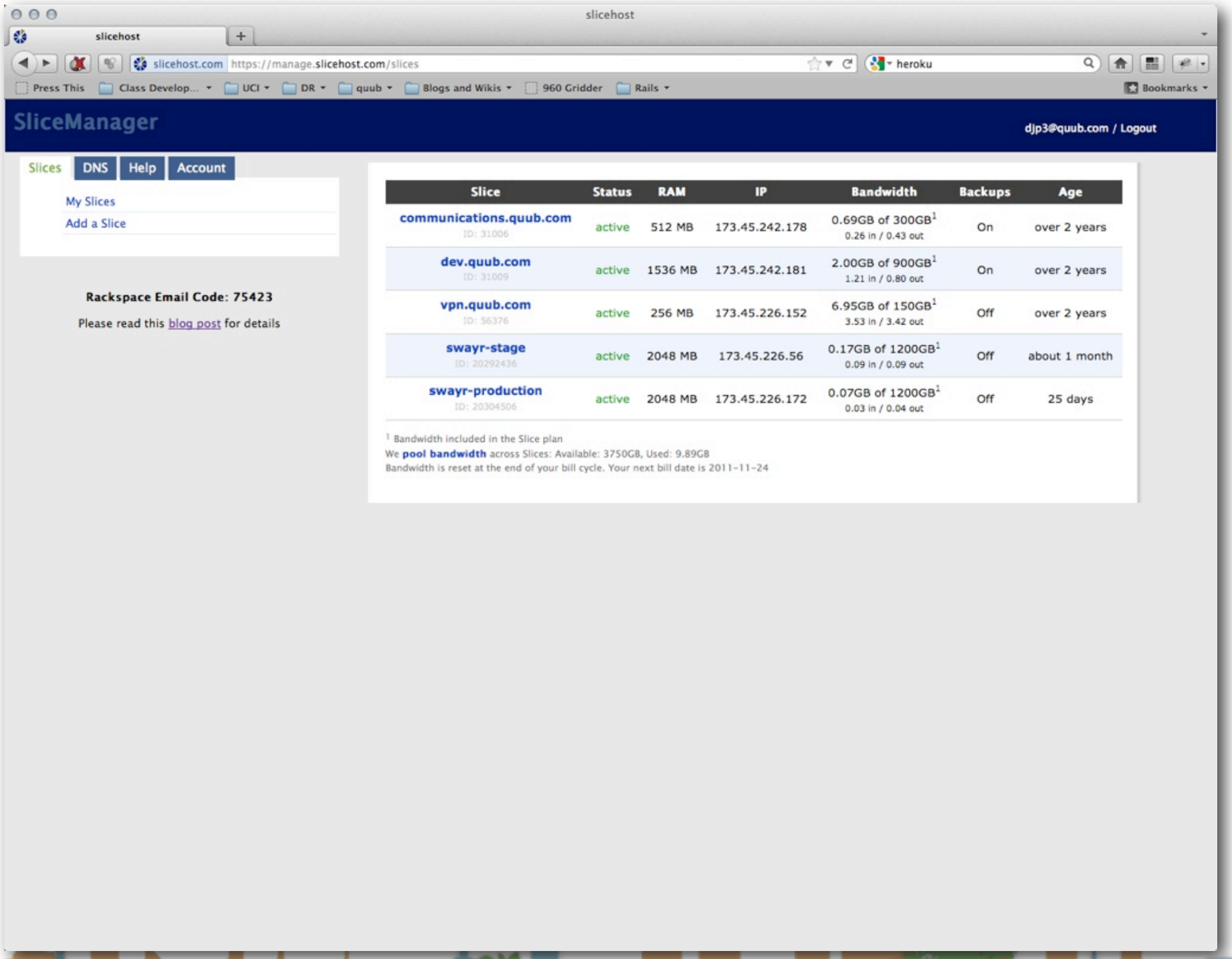
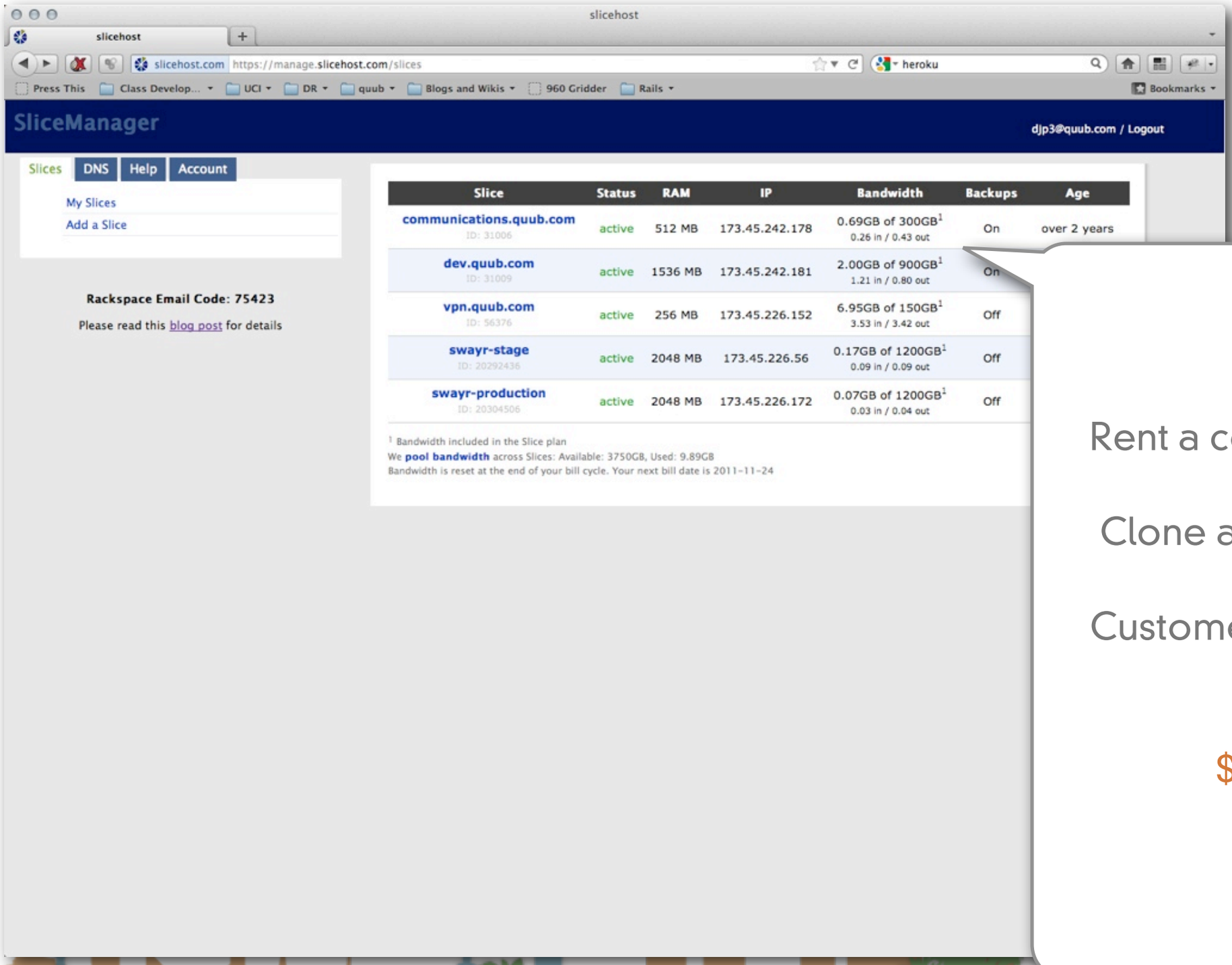
Virtual Machines: Slicehost



Virtual Machines: Slicehost



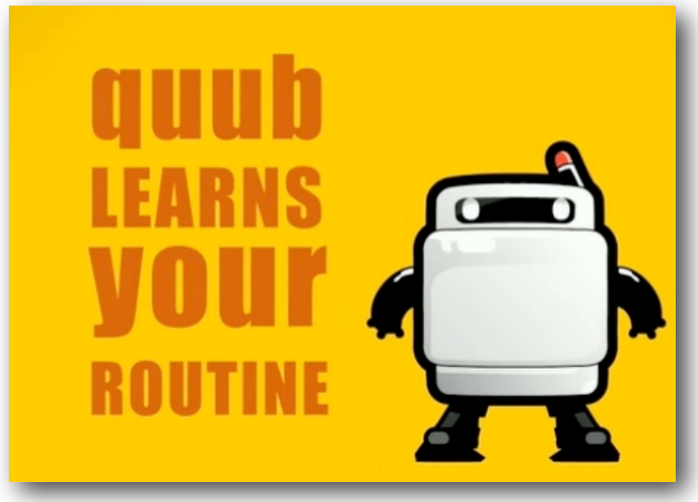
Rent a computer on demand

Clone an existing computer

Customer does all the admin

$40.00 / month

What is my experience?



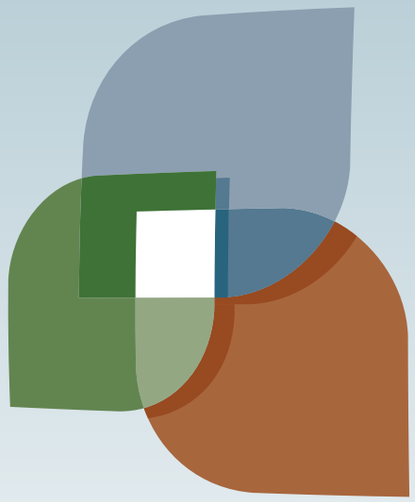
- http://www.quub.com
- http://whisper.fm
- http://swayr.com

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”
- Tried to go into 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



LUCI

Tuesday, January 10, 12