

Amazon Web Services: Building a Web-Scale Computing Infrastructure

Jeff Barr
Senior Web Services Evangelist



Survey Says...

- ❏ Are you an Amazon retail customer?
- ❏ Have you heard of the Amazon Web Services?
- ❏ Have you used them?
- ❏ Which ones (Associates, EC2, S3, SQS)?
- ❏ Have you seen me speak before?
- ❏ Could you give this talk?

Things to Remember

AWS Site: aws.amazon.com

AWS Blog: aws.typepad.com

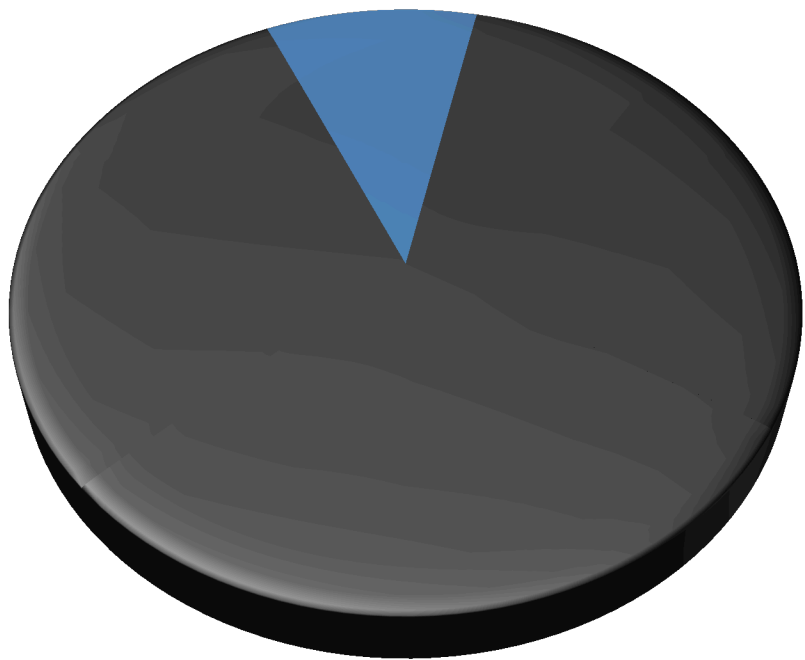
My Email: jbarr@amazon.com

Who am I?

- ❏ Philly native!
- ❏ Software development background
- ❏ Early RSS: Headline Viewer & Syndic8.com
- ❏ Programmable applications and web sites
- ❏ Microsoft Visual Basic and .Net Teams
- ❏ Startup / venture consultant
- ❏ Over 5.5 Years with Amazon:
 - ❏ Senior Developer
 - ❏ Senior Web Services Evangelist
 - ❏ World traveler – Wiki powered



Today's Talk...



- Technical
- Business
- Customer
- Code

Amazon Web Services

- Application building blocks
- Stable APIs
- Proven Amazon infrastructure
- Focus on innovation and creativity
- Long-term investment

Issues Facing Developers

📦 70% of Web Development Effort is:

- 📦 Data Centers
- 📦 Bandwidth / Power / Cooling
- 📦 Operations
- 📦 Staffing



📦 Scaling is Difficult and Expensive:

- 📦 Large Up-Front Investment
- 📦 Invest Ahead of Demand
- 📦 Load is Unpredictable



Dream or Nightmare?

- ❏ Rapid, unexpected customer demand/growth
- ❏ Unpredictable load
- ❏ Slashdot/Digg/TechCrunch
- ❏ “Success disaster”
- ❏ Seasonal spikes



Reality: Cloud Computing

- ❏ Mature Amazon infrastructure
- ❏ Utility pricing
- ❏ Scale capacity on demand
- ❏ Turn fixed costs into variable costs
- ❏ Clean APIs
- ❏ Simple conceptual models
- ❏ Always available
- ❏ Cost-effective



Utility Computing Services Menu

- Amazon Simple Queue Service
- Amazon Simple Storage Service
- Amazon Elastic Compute Cloud
- Amazon Flexible Payments Service
- Amazon SimpleDB
- Amazon DevPay



Amazon Simple Storage Service

S3

Amazon Simple Storage Service

- Object-Based Storage
- 1 B – 5 GB / object
- Fast, Reliable, Scalable
- Redundant, Dispersed
- 99.99% Availability Goal
- Private or Public
- Per-object URLs & ACLs
- US & European Locations

Amazon Simple Storage Service

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**\$.15 per GB
per month
storage**

**\$.01 for 1000 to
10000 requests**



**\$.10 – \$.18 per
GB data transfer**

Amazon S3 Concepts




Objects:

-  Opaque data to be stored (1 byte ... 5 Gigabytes)
-  Authentication and access controls




Buckets:

-  Object container – any number of objects
-  100 buckets per account

Keys:


-  Unique object identifier within bucket
-  Up to 1024 bytes long
-  Flat object storage model








Standards-Based Interfaces:

-  REST and SOAP
-  URL-Addressability – every object has a URL
-  BitTorrent seed



S3 API

 **Service:**
 ListAllMyBuckets

 **Buckets:**
 CreateBucket
 DeleteBucket
 ListBucket
 GetBucketAccessControlPolicy
 SetBucketAccessControlPolicy
 GetBucketLoggingStatus
 SetBucketLoggingStatus

 **Objects:**
 PutObject
 PutObjectInline
 GetObject
 GetObjectExtended
 DeleteObject
 GetObjectAccessControlPolicy
 SetObjectAccessControlPolicy



S3.RB – Establish Connection

```
require 'S3'
```

```
AWS_ACCESS_KEY = '<your key>'
```

```
AWS_SECRET_ACCESS_KEY = '<your key>'
```

```
conn = S3::AWSAuthConnection.new  
  (AWS_ACCESS_KEY_ID,  
  AWS_SECRET_ACCESS_KEY,  
  false)
```

S3.RB – Create Bucket

```
BUCKET_NAME = 'assets'  
conn.create_bucket(BUCKET_NAME)
```

S3.RB – Upload File

```
datafile = File.open(path)
Key = path.basename;

conn.put(BUCKET_NAME, key, datafile.read,
{"Content-Type" => mime,
 "Content-Length" => File.size(path).to_s,
 "x-amz-acl" => "public-read"})

http://assets.sample.com/...
```

Common Amazon S3 Use Cases

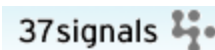
Media Sharing

 NRK, Smugmug, Blingee, Ringo



Media/Software Distribution

 Microsoft, Liberated Syndication, Linden Lab



Backup (Server and PC)

 Mailtrust



Online Storage

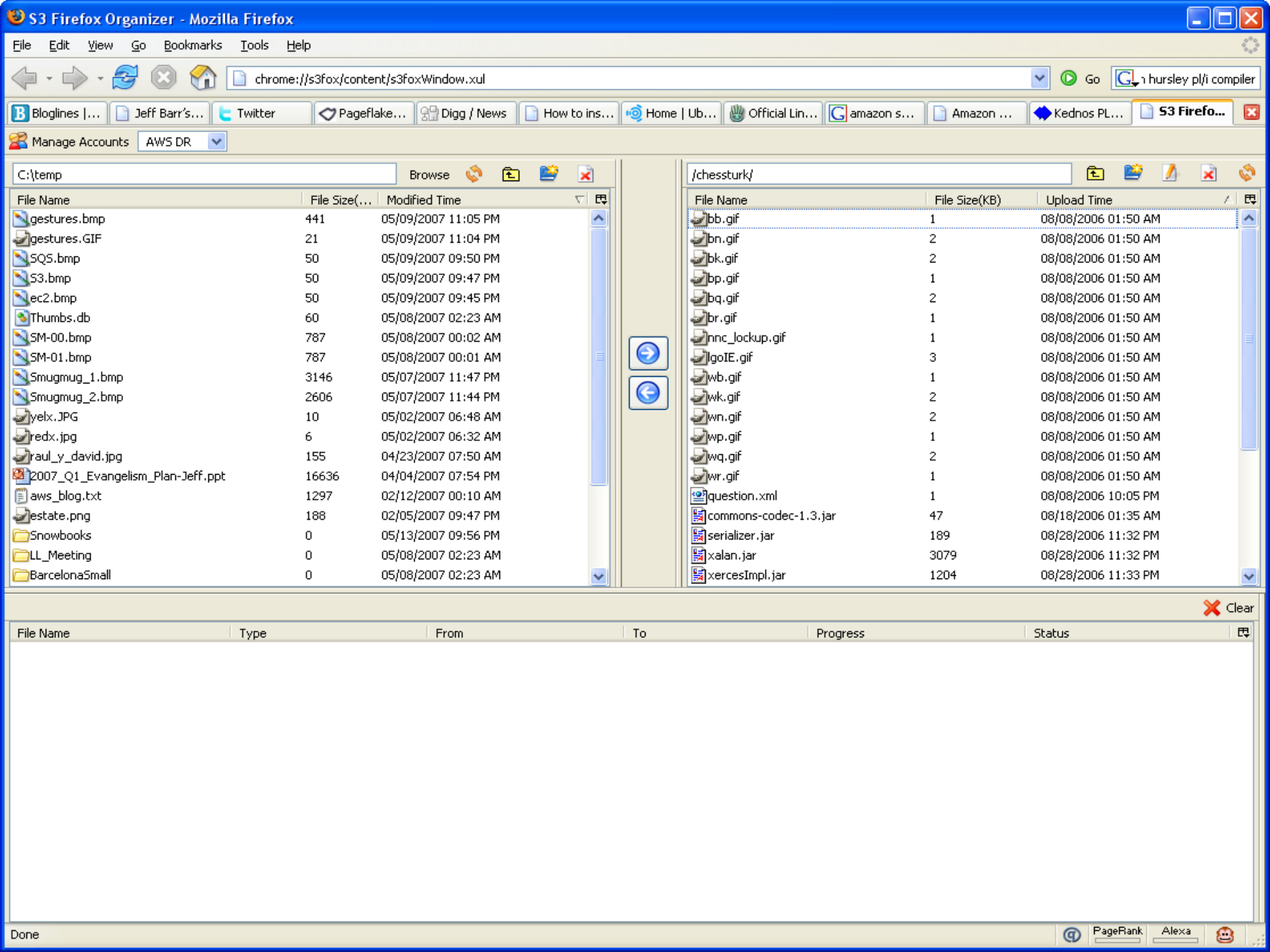
 MyDataBus, SendAlong



Application Storage

 37 Signals, Xerox Global Services





File Name	File Size(...)	Modified Time
gestures.bmp	441	05/09/2007 11:05 PM
gestures.GIF	21	05/09/2007 11:04 PM
5QS.bmp	50	05/09/2007 09:50 PM
53.bmp	50	05/09/2007 09:47 PM
ec2.bmp	50	05/09/2007 09:45 PM
Thumbs.db	60	05/08/2007 02:23 AM
SM-00.bmp	787	05/08/2007 00:02 AM
SM-01.bmp	787	05/08/2007 00:01 AM
Smugmug_1.bmp	3146	05/07/2007 11:47 PM
Smugmug_2.bmp	2606	05/07/2007 11:44 PM
yelx.JPG	10	05/02/2007 06:48 AM
redx.jpg	6	05/02/2007 06:32 AM
raul_y_david.jpg	155	04/23/2007 07:50 AM
2007_Q1_Evangelism_Plan-Jeff.ppt	16636	04/04/2007 07:54 PM
aws_blog.txt	1297	02/12/2007 00:10 AM
estate.png	188	02/05/2007 09:47 PM
Snowbooks	0	05/13/2007 09:56 PM
LL_Meeting	0	05/08/2007 02:23 AM
BarcelonaSmall	0	05/08/2007 02:23 AM

File Name	File Size(KB)	Upload Time
bb.gif	1	08/08/2006 01:50 AM
bn.gif	2	08/08/2006 01:50 AM
bk.gif	2	08/08/2006 01:50 AM
bp.gif	1	08/08/2006 01:50 AM
bq.gif	2	08/08/2006 01:50 AM
br.gif	1	08/08/2006 01:50 AM
nnc_lockup.gif	1	08/08/2006 01:50 AM
goIE.gif	3	08/08/2006 01:50 AM
wb.gif	1	08/08/2006 01:50 AM
wk.gif	2	08/08/2006 01:50 AM
wn.gif	2	08/08/2006 01:50 AM
wp.gif	1	08/08/2006 01:50 AM
wq.gif	2	08/08/2006 01:50 AM
wr.gif	1	08/08/2006 01:50 AM
question.xml	1	08/08/2006 10:05 PM
commons-codec-1.3.jar	47	08/18/2006 01:35 AM
serializer.jar	189	08/28/2006 11:32 PM
xalan.jar	3079	08/28/2006 11:32 PM
xercesImpl.jar	1204	08/28/2006 11:33 PM

File Name	Type	From	To	Progress	Status

Amazon Elastic Compute Cloud

EC2



Amazon Elastic Compute Cloud

- Virtual Compute Cloud
- Root-level System Access
- Elastic Capacity
- Management API
- Scale in Minutes
- Multiple Instance Sizes
- Network Security Model

**\$.10–\$.80
per server
hour**

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GB data transfer**

EC2 Instance Types

S

1.7 GB RAM
1 EC2 Compute
Unit
160 GB
32-bit platform

\$0.10/
Hr

L

7.5 GB RAM
4 EC2 Compute
Units
850 GB
64-bit platform



\$0.40/
Hr





XL




15 GB RAM
8 EC2 Compute
Units
1690 GB
storage,
64-bit platform

\$0.80/
Hr

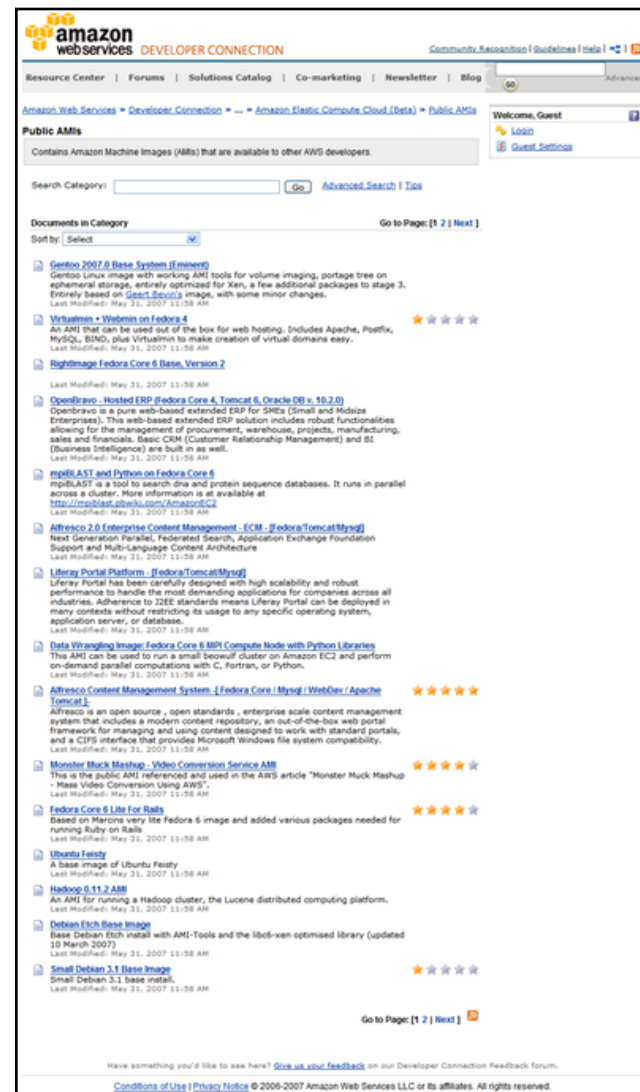
Amazon EC2 Concepts

- 
Amazon Machine Image (AMI):
 -  Bootable root disk stored in S3
 -  Pre-defined or user-built
 -  Catalog of user-built AMIs
 -  OS: Fedora, Centos, Gentoo, Debian, Ubuntu, Windows Server
 -  App Stack: LAMP, mpiBLAST, Hadoop

- 
Instance:
 -  Running copy of an AMI
 -  Launch in less than 2 minutes
 -  Start/stop programmatically




- 
Network Security Model:
 -  Explicit access control
 -  Security groups

- 
Inter-service bandwidth is free








EC2 API

Images:

-  RegisterImage
-  DescribeImages
-  DeregisterImage

Instances:

-  RunInstances
-  DescribeInstances
-  TerminateInstances
-  GetConsoleOutput
-  RebootInstances

Keypairs:












-  CreateKeyPair
-  DescribeKeyPairs
-  DeleteKeyPair

Image Attributes:

-  ModifyImageAttribute
-  DescribeImageAttribute
-  ResetImageAttribute





Security Groups:

-  CreateSecurityGroup
-  DescribeSecurityGroups
-  DeleteSecurityGroup
-  AuthorizeSecurityGroupIngress
-  RevokeSecurityGroupIngress

Newest EC2 Features (Today)



Elastic IP Addresses:

-  `AllocateAddress`
-  `ReleaseAddress`
-  `AssociateAddress`
-  `DisassociateAddress`



Availability Zones:

-  `DescribeAvailabilityZones`
-  `RunInstances`

User Selectable Kernels

Amazon EC2 At Work

Startups

-  Cruxy – Media transcoding
-  Podango – Podcast management




Science / Research:

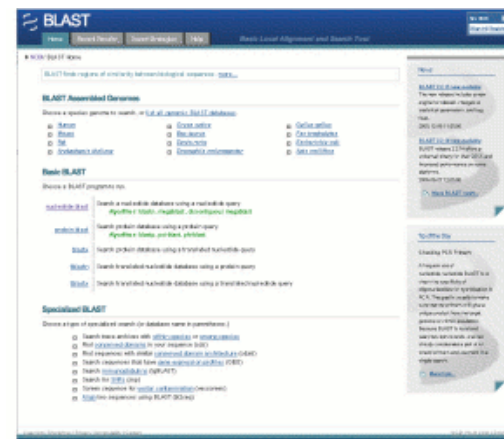
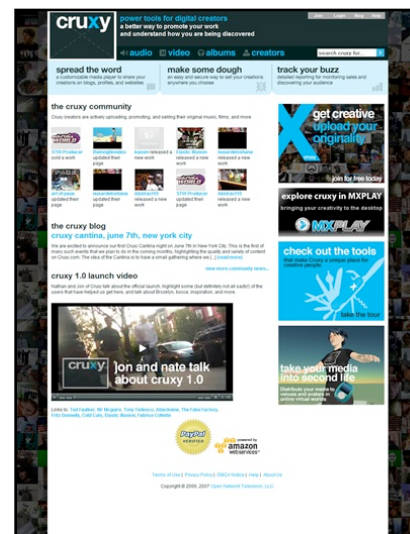
-  Hadoop / MapReduce
-  mpiBLAST

Load-Management and Load Balancing Tools:

-  Rightscale
-  Scalr

Corporate:

-  New York Times
-  High-Impact, Short-Term Projects
-  Development /test host



“Prorated Super Computing Fun” – The New York Times

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The New York Times
Tuesday, February 12, 2008

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OPEN

All the Code That's Fit to `printf()`


[Back to front page »](#)

November 1, 2007, 5:30 pm

Self-service, Prorated Super Computing Fun!

By DEREK GOTTFRID
TAGS: AWS, EC2, HADOOP, MAPREDUCE, S3

As part of [eliminating TimeSelect](#), [The New York Times](#) has decided to make all the public domain articles from 1851-1922 available free of charge. These articles are all in the form of images scanned from the original paper. In fact from 1851-1980, all 11 million articles are available as images in PDF format. To generate a PDF version of the article takes quite a bit of work — each article is actually composed of numerous smaller TIFF images that need to be scaled and glued together in a coherent fashion.



Magic EC2 / S3 Button

Previously we had generated all the PDFs dynamically. This approach had worked reasonably well, but with the strong possibility of a significant traffic increase we started to rethink things. Clearly, pre-generating all the articles and statically serving them would be a great option. Pretty quickly I thought about how we could do this (and have some fun along the way,

- 1851-1922 Articles
- TIFF -> PDF
- Input: 11 Million Articles (4TB of data)
- What did he do?
 - 100 EC2 Instances for 24 hours
 - All data on S3
 - Output: 1.5 TB of Data
 - Hadoop, iText, JetS3t

RightScale Platform

RIGHT SCALESM

matthew@rightscale.com; DEMO [Logout](#)

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Servers

- ServerTemplates
- RightScripts
- Credentials

EC2

- Images
- Security Groups
- SSH Keys

Alerts

- Specs
- Escalations

[Report](#)
[Settings](#)

Overview

[Help](#)

Instances

Nickname	Template/Image	DNS	State	Runtime
Httpperf AutoScaling (LG)	Httpperf AutoScaling (LG)	ec2-72-44-38-105.compute-1.amazonaws.com	operational	4.0 days

Deployment [scalable photo site](#) ●●●●●

Nickname	Server Template	DNS	State	Runtime
db-master MySQL	MySQL Bootstrap v5	ec2-67-202-2-222.compute-1.amazonaws.com	operational	4.0 days
db-slave MySQL	MySQL Additional v6	ec2-67-202-54-163.compute-1.amazonaws.com	operational	4.0 days
www8a front-end	Rails FrontEnd v3	ec2-67-202-32-31.compute-1.amazonaws.com	operational	4.0 days
www8b front-end	Rails FrontEnd v3	ec2-67-202-54-148.compute-1.amazonaws.com	operational	4.0 days

Recent Tasks 16:32

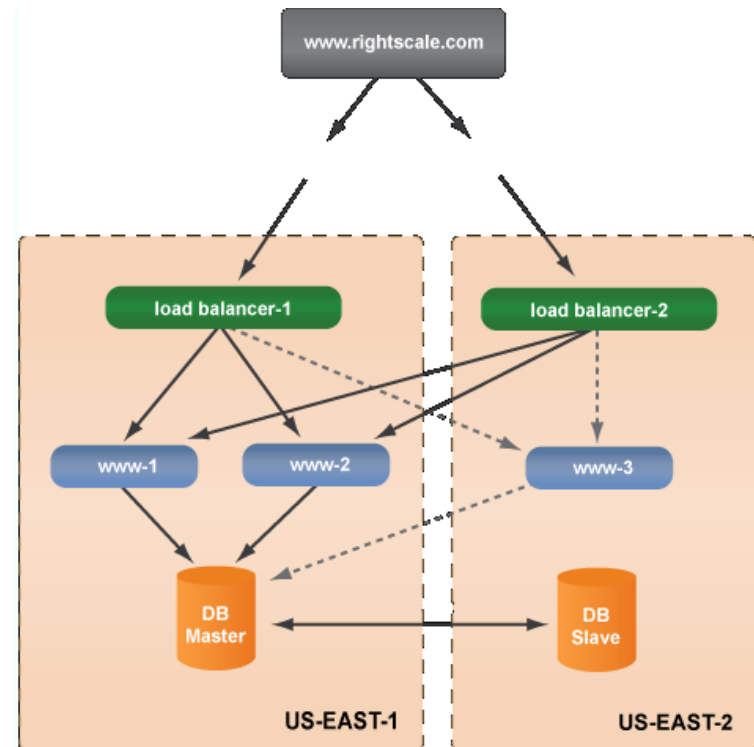
Task/Status	Age
Resize array action 100% -- done	1h
PERF httpperf launch 100% -- done	18m

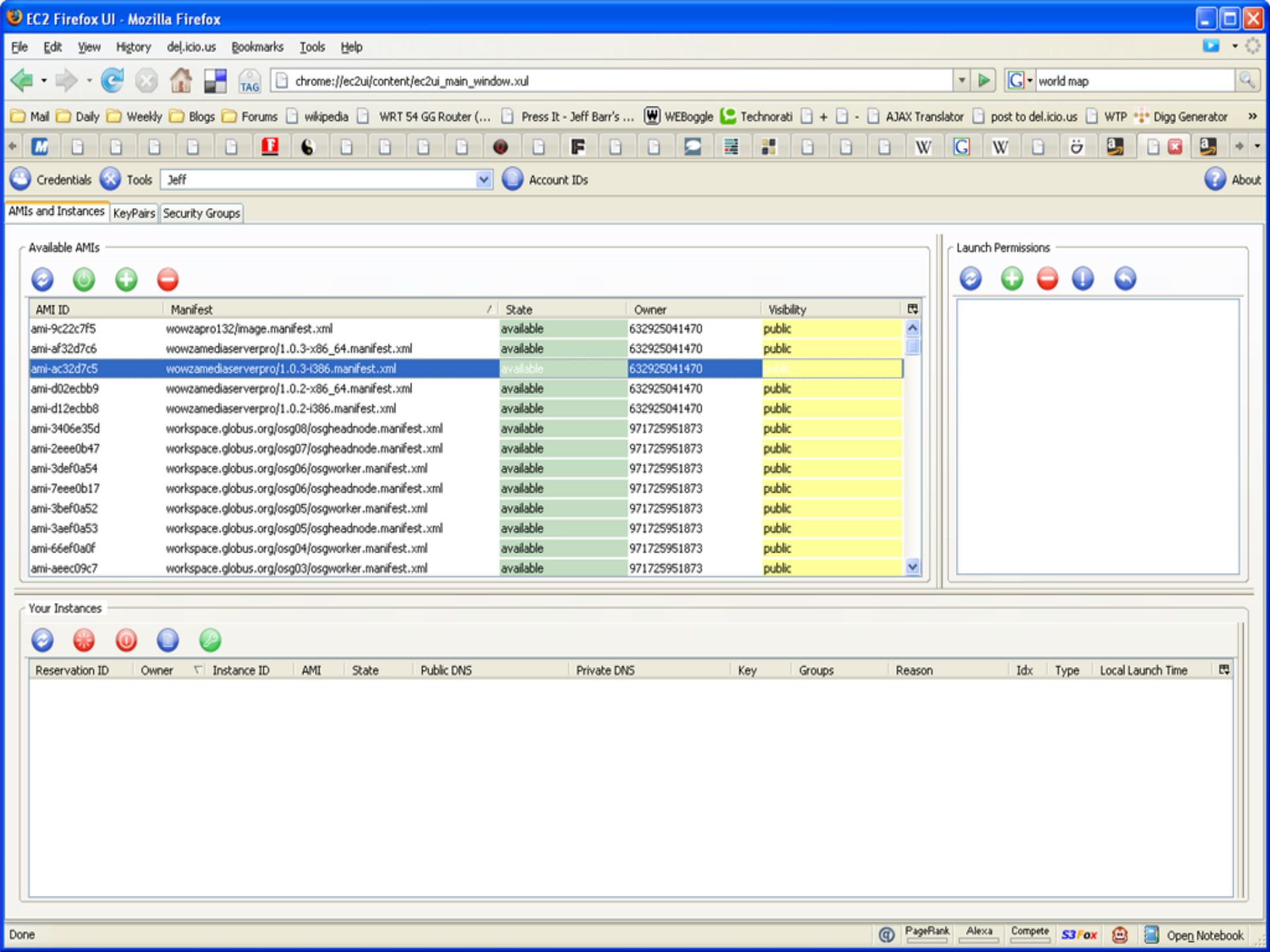
Deployment [Apache-TomCat5 PHP Server](#) ●●●●●

Deployment [Demo Deployment](#) ●●●●●

Deployment [Mephisto multi-server v1](#) ●●●●●

Deployment [TVE's scalable demo site](#) ●●●●●





chrome://ec2ui/content/ec2ui_main_window.xul world map

Mail Daily Weekly Blogs Forums wikipedia WRT 54 GG Router (...) Press It - Jeff Barr's ... WEBoggle Technorati AJAX Translator post to del.icio.us WTP Digg Generator

Credentials Tools Jeff Account IDs About

AMIs and Instances KeyPairs Security Groups

Available AMIs

AMI ID	Manifest	State	Owner	Visibility
ami-9c22c7f5	wowzapro132/image.manifest.xml	available	632925041470	public
ami-af32d7c6	wowzamediaserverpro/1.0.3-x86_64.manifest.xml	available	632925041470	public
ami-ac32d7c5	wowzamediaserverpro/1.0.3-i386.manifest.xml	available	632925041470	public
ami-d02ecbb9	wowzamediaserverpro/1.0.2-x86_64.manifest.xml	available	632925041470	public
ami-d12ecbb8	wowzamediaserverpro/1.0.2-i386.manifest.xml	available	632925041470	public
ami-3406e35d	workspace.globus.org/osg08/osgheadnode.manifest.xml	available	971725951873	public
ami-2eee0b47	workspace.globus.org/osg07/osgheadnode.manifest.xml	available	971725951873	public
ami-3def0a54	workspace.globus.org/osg06/osgworker.manifest.xml	available	971725951873	public
ami-7eee0b17	workspace.globus.org/osg06/osgheadnode.manifest.xml	available	971725951873	public
ami-3bef0a52	workspace.globus.org/osg05/osgworker.manifest.xml	available	971725951873	public
ami-3aef0a53	workspace.globus.org/osg05/osgheadnode.manifest.xml	available	971725951873	public
ami-66ef0a0f	workspace.globus.org/osg04/osgworker.manifest.xml	available	971725951873	public
ami-aec09c7	workspace.globus.org/osg03/osgworker.manifest.xml	available	971725951873	public

Launch Permissions

Your Instances

Reservation ID	Owner	Instance ID	AMI	State	Public DNS	Private DNS	Key	Groups	Reason	Idx	Type	Local Launch Time
----------------	-------	-------------	-----	-------	------------	-------------	-----	--------	--------	-----	------	-------------------

Done PageRank Alexa Compete S3Fox Open Notebook

Amazon Simple Queue Service

SQS

Amazon Simple Queue Service

- Scalable Queuing
- Elastic Capacity
- Reliable, Simple, Secure

Inter-process messaging, data buffering, scalable architecture component

**\$.01 per
10000
messages**

Amazon Simple Queue Service

- Scalable Queuing
- Elastic Capacity
- Reliable, Simple, Secure



Inter-process messaging, data buffering, scalable architecture component

**\$.01 per
10000
messages**



**\$.10 – \$.18 per
GB data transfer**

SQS API

Queues:

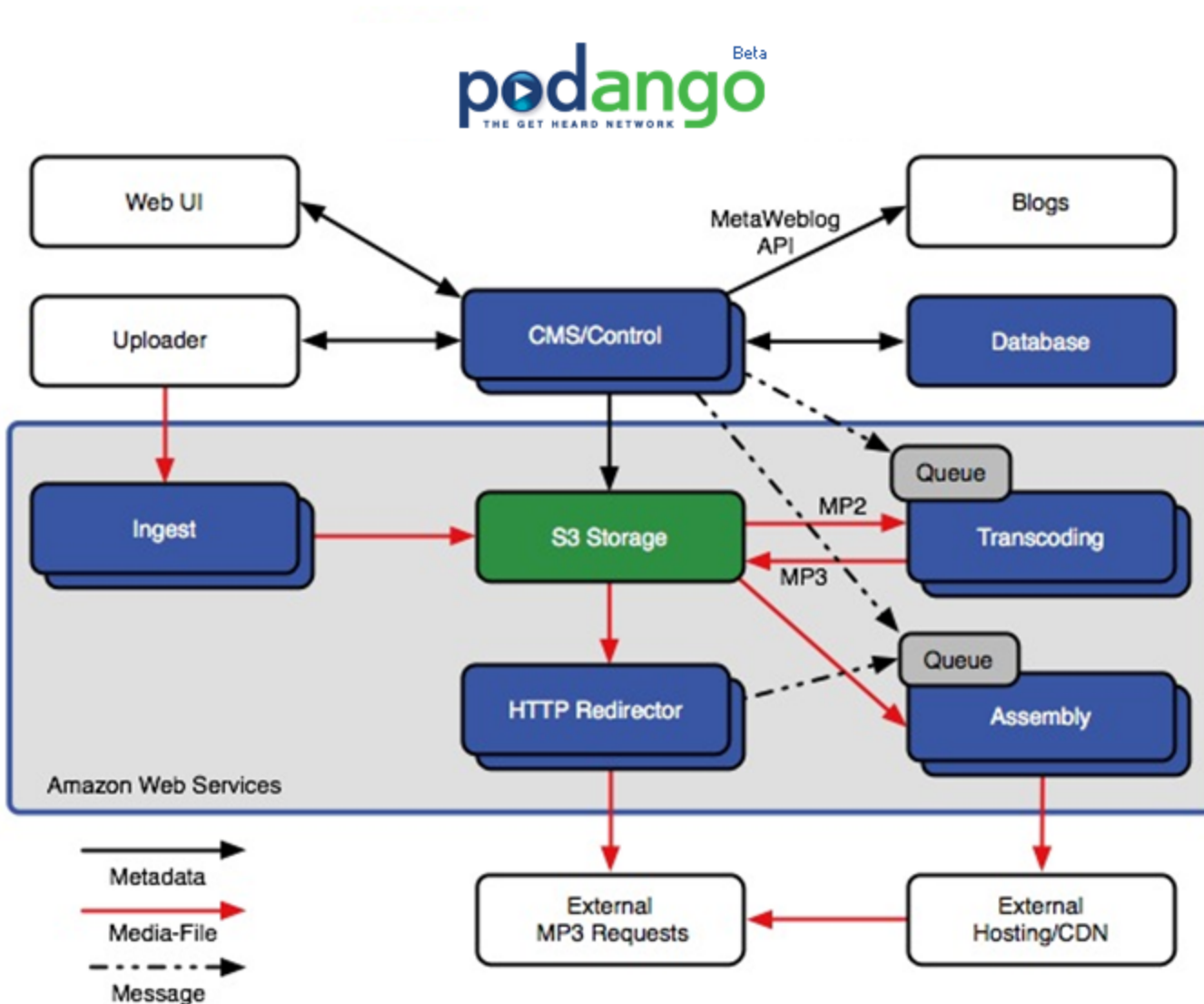
-  CreateQueue
-  ListQueues
-  DeleteQueue

Messages:

-  SendMessage
-  ReceiveMessage
-  DeleteMessage



Amazon SQS At Work



Amazon SimpleDB

SDB

Amazon SimpleDB Service

- Distributed Data Store
- Structured Storage
- Fully Indexed
- Redundant
- Scalable
- Elastic Capacity
- Query Language

**\$1.50 per GB
per month**

Amazon SimpleDB Service

- Distributed Data Store
- Structured Storage
- Fully Indexed
- Redundant
- Scalable
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- Query Language

**\$1.50 per GB
per month**

**\$.10 – \$.18 per GB
data transfer**

**\$.14 per CPU hour
(query processing)**

SimpleDB Concepts

- 📦 **Domain:**
 - 📦 Collection of similar items
 - 📦 Query language
 - 📦 Any number of items per domain (10 GB beta limit)
 - 📦 100 domains per account

- 📦 **Item:**
 - 📦 Collection of key-value pairs (attributes)
 - 📦 Multiple values per attribute
 - 📦 Up to 256 attributes per item
 - 📦 Up to 1024 bytes per value




- 📦 **Billing:**
 - 📦 Data storage
 - 📦 CPU utilization
 - 📦 Data storage

itemID	description	color	material
123	Sweater	Blue, Red	
456	Dress shirt	White, Blue	
789	shoes	Black	Leather

SimpleDB API



Domains:

-  CreateDomain
-  ListDomains
-  DeleteDomain








Items:

-  PutAttributes
-  Query
-  GetAttributes








Query Language (samples):




-  ['Title' = 'The Right Stuff']
-  ['Number of Pages' < '00310']
-  ['Rating' = '***' or 'Rating' = '*****']
-  ['Year' > '1950' and 'Year' < '1960' or 'Year' starts-with '193' or 'Year' = '2007']
-  ['Keyword' = 'Frank Miller'] union ['Rating' starts-with '*****']

Other Amazon Infrastructure Services

Flexible Payments Service:

-  Move money between any two people or systems.
-  Credit cards, bank accounts, Amazon Payments.
-  One-time, multiple, or recurring transactions.
-  Payment processing language (Gatekeeper).
-  Aggregated transactions (micropayments).

DevPay:

-  Wrap custom business models around S3 and EC2.
-  Set custom prices for each charging unit.
-  Charge for your applications.

Web Services Billing

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[Amazon E-Commerce Service](#)
[Amazon Elastic Compute Cloud \(Beta\)](#)
[Amazon Historical Pricing](#)
[Amazon Mechanical Turk \(Beta\)](#)
[Amazon Simple Storage Service](#)
[Amazon Simple Queue Service](#)
[Alexa Web Services](#)

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Developer Connection

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[Newsletter](#)

Account Number: 8892-7910-8296

[Go to Last Month's Statement](#)

Billing Statement: June 1, 2007

Billing Cycle for this Report: May 1 - May 31, 2007

Usage Charges	Rate	Usage	Totals
Alexa Web Information Service			
View/Edit Service	\$0.00015 per request (\$0.15 for 1,000 requests)	0 Requests	0.00
		Usage Report	0.00
Amazon Simple Storage Service			
View/Edit Service	\$0.20 per GB of data transferred (details)	3,415 GB	0.69
	\$0.15 per GB-Month of storage used (details)	9,222 GB-Mo	1.39
		Usage Report	2.08
Amazon Elastic Compute Cloud			
View/Edit Service	\$0.10 per instance hour consumed (or part of an hour consumed)	0 Hrs	0.00
	\$0.20 per GB of data transferred outside of Amazon (i.e. Internet traffic)	0 WANUsage	0.00
		Usage Report	0.00
Amazon Simple Queue Service			
View/Edit Service	\$0.20 per GB of bandwidth transferred	0.000 GB	0.00
	\$0.10 per 1000 messages	0 Messages	0.00
		Usage Report	0.00
Subtotal			\$ 2.08
Taxes			
Taxes			\$ 0.00
Charges for June 1, 2007			\$ 2.08

(Charged to your credit card on June 1, 2007) Visit the [Amazon Web Services FAQ](#) to learn more about web services pricing models and billing.

All web services are sold by Amazon Web Services LLC

Summary of Last Month's Statement: April 1 - April 30, 2007

Total Charges for April 1 - April 30, 2007 **\$ 1.71**

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Current Billing Period

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[Jeff's Store](#)
[Make Money](#)
[See All 34 Product Categories](#)
[Your Account](#)
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Account Activity

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- [FAQs](#)

Browse Web Services

- [Amazon E-Commerce Service](#)
- [Amazon Elastic Compute Cloud \(EC2\)](#)

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			2.08

Amazon Simple Storage Service

[View/Edit Service](#)

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[Usage Report](#)

Developer Connection

- [Resource Center](#)
- [Forums](#)
- [Blog](#)
- [Newsletter](#)

Usage Charges	Rate	Usage	Totals
Subtotal			\$ 2.08
Taxes			\$ 0.00
Charges for June 1, 2007			\$ 2.08

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View a Previous Statement:

Current Billing Period

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The Commercial Side

- 📦 Standard licensing terms
- 📦 Commercially usable
- 📦 Monthly credit card billing
- 📦 Self-serve model:
 - 📦 Sign up as developer
 - 📦 Choose services
 - 📦 Agree to service licenses
 - 📦 Enter payment info
 - 📦 Start coding



The screenshot shows the Amazon Web Services Licensing Agreement page. The top navigation bar includes links for Amazon.com Prime, Jeff's Amazon.com, Make Money, See All 41 Product Categories, Your Account, and Cart. Below this is a search bar and a "Find Gifts" button. The main heading is "Web Services Licensing Agreement" with a subheading "Updated March 22, 2007". The page is divided into two main sections: "Learn About Amazon Web Services" and "Browse Web Services". The "Learn About Amazon Web Services" section includes links for AWS Home, Why Use AWS?, What's New in AWS?, Upcoming Events, Success Stories, Solutions Catalog, Create an Account, Contact Us, and FAQs. The "Browse Web Services" section includes links for Amazon E-Commerce Service, Amazon Elastic Compute Cloud (Beta), Amazon Historical Pricing, Amazon Mechanical Turk (Beta), Amazon Simple Storage Service, Amazon Simple Queue Service, and Alexa Web Services. The "CONTENTS" section lists "Introduction and Definitions" and "Section 7: Service Specific Terms", which includes links for Amazon E-Commerce Service (Amazon ECS), Amazon Simple Storage Service (Amazon S3), Amazon Simple Queue Service (Amazon SQS), Alexa Services, and Amazon Elastic Compute Cloud (Amazon EC2). The main body of the page contains the text of the agreement, starting with "Amazon Web Services LLC and/or its affiliates provide Amazon Web Services (AWS) to you subject to the following terms and conditions. You agree, or the applicable age of consent under local law, or older to Services. THIS IS A LEGAL AGREEMENT BETWEEN YOU AND AMAZON. ALL TERMS AND CONDITIONS IN THIS AGREEMENT BEFORE CHECKING OUT ON THE AMAZON WEB SERVICES ACCOUNT CREATION PAGE. BY COMPLETING YOUR ACCOUNT CREATION, YOU ARE REPRESENTING THAT YOU ARE AT LEAST 18 YEARS OLD, OR THE APPLICABLE AGE OF CONSENT UNDER LOCAL LAW, AND HAVE THE AUTHORITY TO BIND YOURSELF OR YOUR COMPANY TO THESE TERMS AND CONDITIONS. If you do not agree, you may decline this Agreement by not checking out on the Amazon Web Services Account Creation Page and discontinuing the account creation process. If you do not agree to these terms and conditions, you will not be able to complete the account creation process or access Amazon Web Services." The page also includes a definition of "Agreement" and a statement that the agreement applies to all Amazon Web Services that you sign up for.

Q & A



Things to Remember

AWS Site: aws.amazon.com

AWS Blog: aws.typepad.com

My Email: jbarr@amazon.com