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Cloud Computing

Big Data is married to the Cloud: Scalable computing and storage for everyone

The McGraw-Hill Companies

DECEMBER 24, 2007 | BUSINESSWEEK.COM

BusinessWeek

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NEXT Imagine what you can do

MEXICO: THE UGLY SIDE OF MICRO-LLOANS 038

CENTRAL BANKERS TO THE RESCUE 025

An Early Look at Java

App Engine is unveiling its self-managing runtime, integration with Google's Java solution for AJAX web apps, and we're eager to get your help who sign up, but we'll be includin

- Get the full scoop in our blog
- Click over to YouTube to see our video
- See our docs for other info on data.

Explore Azure Services Platform

The Azure Services Platform provides a wide range of internet services that can be consumed from both on-premises environments or the Internet.

Christophe Bisciglia, Google's master of "cloud" computing

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Developers Simply sign up & start developing in the cloud with these resources and tools:

- Technical Documentation
- Cloud Architectures Whitepaper (pdf)
- Amazon Machine Images
- AWS Community Forums

Business Managers Learn how Amazon Web Services enables you to reach business goals faster:

- AWS Solutions for Enterprise Customers
- Security Whitepaper (pdf)
- Case Studies & Customer Testimonials
- AWS Blog (RSS)

What's New? Media Coverage Events

May 07, 2009 Amazon CloudFront Adds Access Logging Capability

Apr 29, 2009 AWS Goes To School With Programs For Educators, Researchers, and Students

Apr 22, 2009 Amazon EC2 Running IBM Now Available

Apr 15, 2009 Amazon EC2 Reserved Instances Now Available in Europe

Apr 09, 2009 Announcing Amazon SQS WSDL Version 2009-02-01 and Amazon SQS in Europe

Explore Products

Infrastructure Services

- Amazon Elastic Compute Cloud (Amazon EC2)
- Amazon SimpleDB
- Amazon Simple Storage Service (Amazon S3)
- Amazon CloudFront
- Amazon Simple Queue Service (Amazon SQS)
- Amazon Elastic MapReduce
- AWS Premium Support

Payments & Billing

On-Demand Workforce

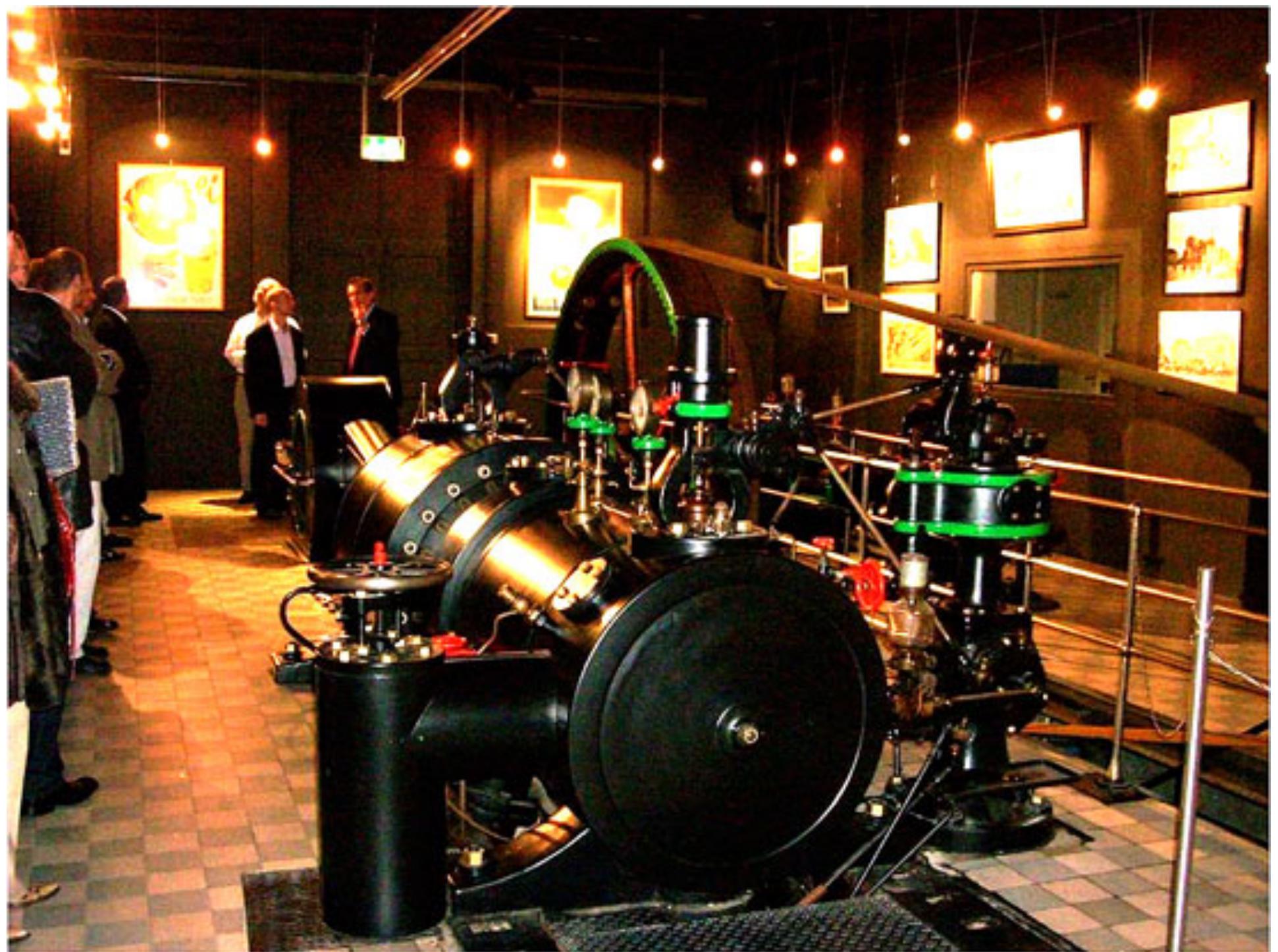
Alexa Web Services

News & Events

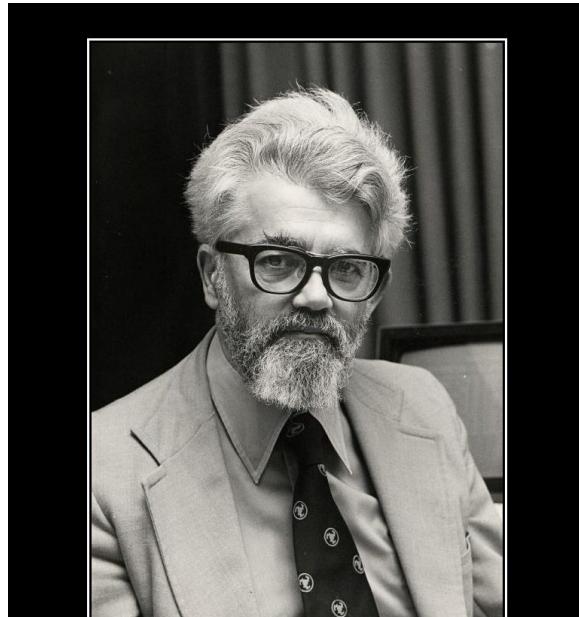
The background of the image is a photograph of a sky filled with various types of clouds, from wispy cirrus to denser cumulus and cumulonimbus. The colors range from bright white to deep blue.

Economies of Scale
Elasticity

Motivation



"... computing may someday be organized as a public utility just as the telephone system is a public utility... The computer utility could become the basis of a new and important industry."



-- *John McCarthy*

Emeritus at Stanford

Inventor of LISP

1961



Economies of Scale

Technology	Cost in Medium-sized DC	Cost in Very Large DC	Ratio
Network	\$95 per Mbit/sec/month	\$13 per Mbit/sec/month	7.1
Storage	\$2.20 per GByte / month	\$0.40 per GByte / month	5.7
Administration	>140 Servers / Administrator	>1000 Servers / Administrator	7.1



src: Armbrust et al., Above the Clouds: A Berkeley View of Cloud Computing, 2009



Economies of Scale

	WAN bandwidth/mo.	CPU hours (all cores)	disk storage
Item in 2003	1 Mbps WAN link	2 GHz CPU, 2 GB DRAM	200 GB disk, 50 Mb/s transfer rate
Cost in 2003	\$100/mo.	\$2000	\$200
\$1 buys in 2003	1 GB	8 CPU hours	1 GB
Item in 2008	100 Mbps WAN link	2 GHz, 2 sockets, 4 cores/socket, 4 GB DRAM	1 TB disk, 115 MB/s sustained transfer
Cost in 2008	\$3600/mo.	\$1000	\$100
\$1 buys in 2008	2.7 GB	128 CPU hours	10 GB
cost/performance improvement	2.7x	16x	10x
Cost to rent \$1 worth on AWS in 2008	\$0.27–\$0.40 (\$0.10–\$0.15/GB × 3 GB)	\$2.56 (128× 2 VM's@\$0.10 each)	\$1.20–\$1.50 (\$0.12–\$0.15/GB-month × 10 GB)

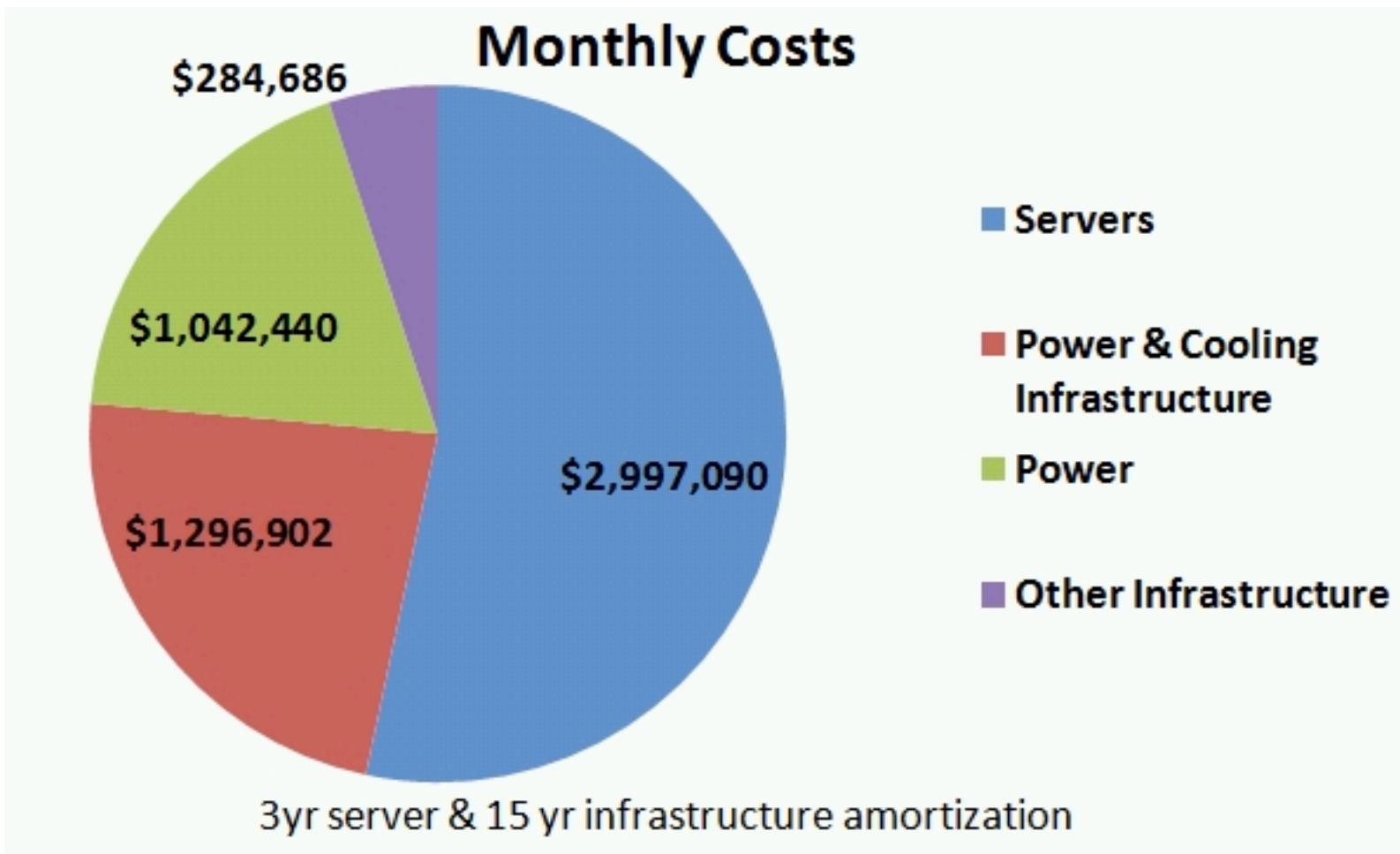
src: Armbrust et al., Above the Clouds: A Berkeley View of Cloud Computing, 2009



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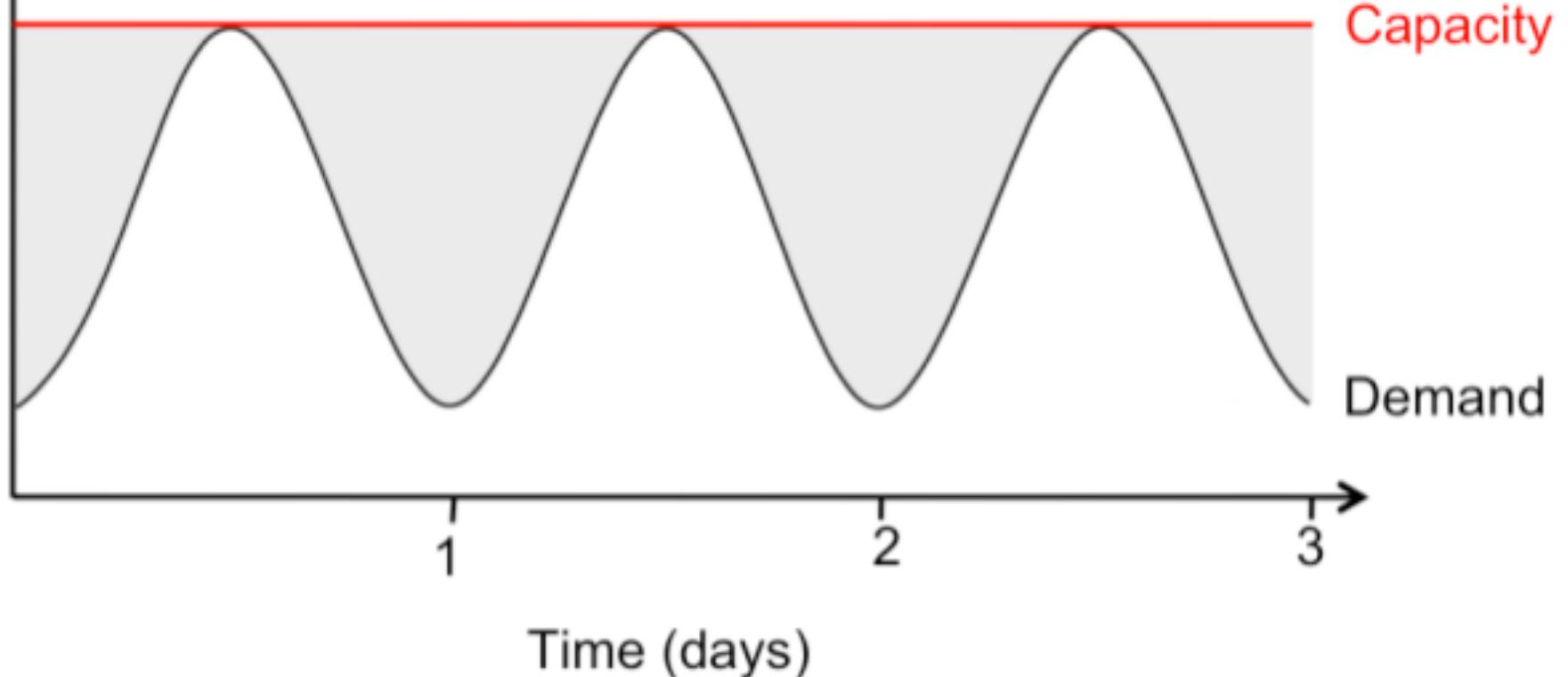
**Utilization,
Power,
Cooling?**

Economies of Scale



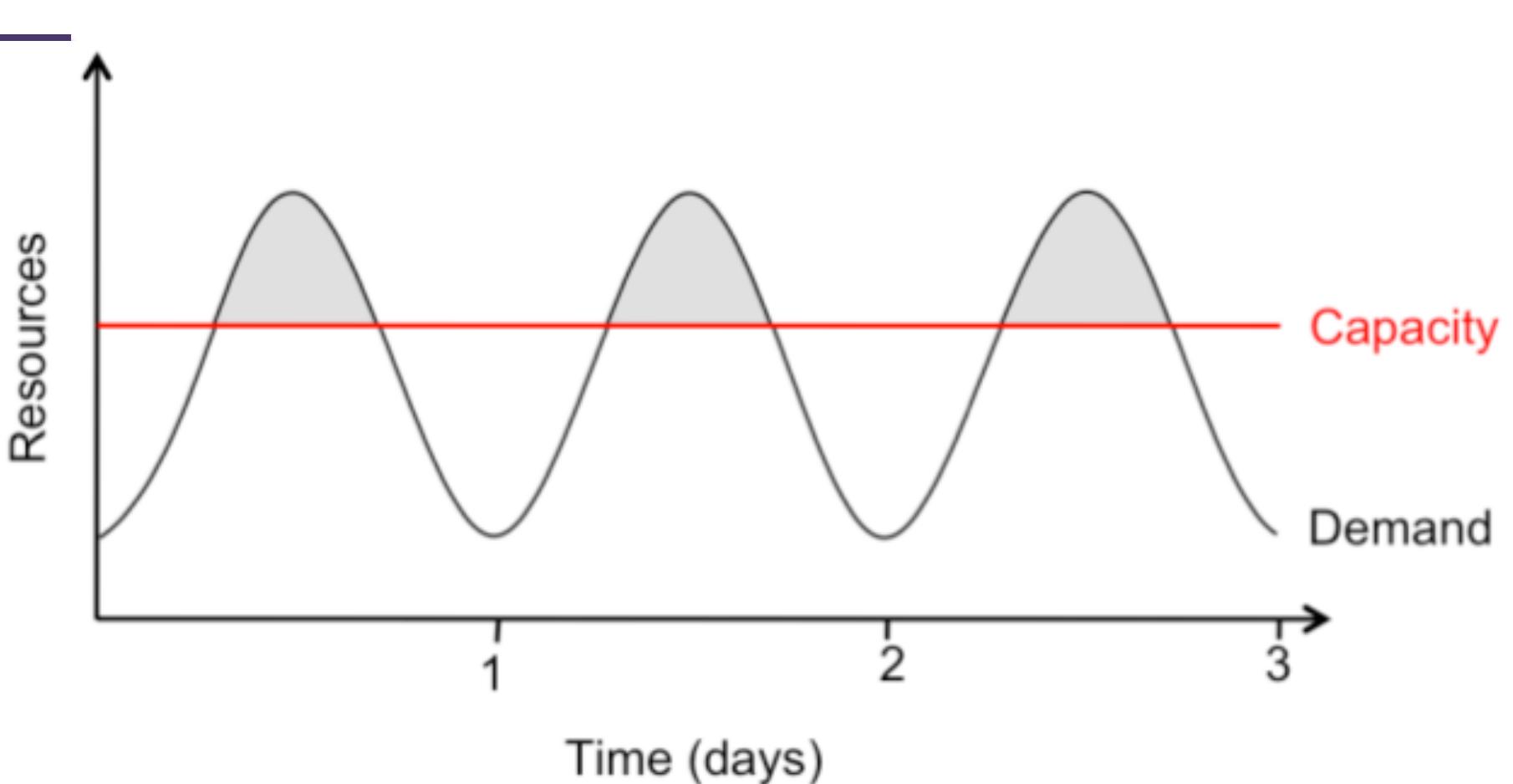
src: James Hamilton, Amazon.com

Resources



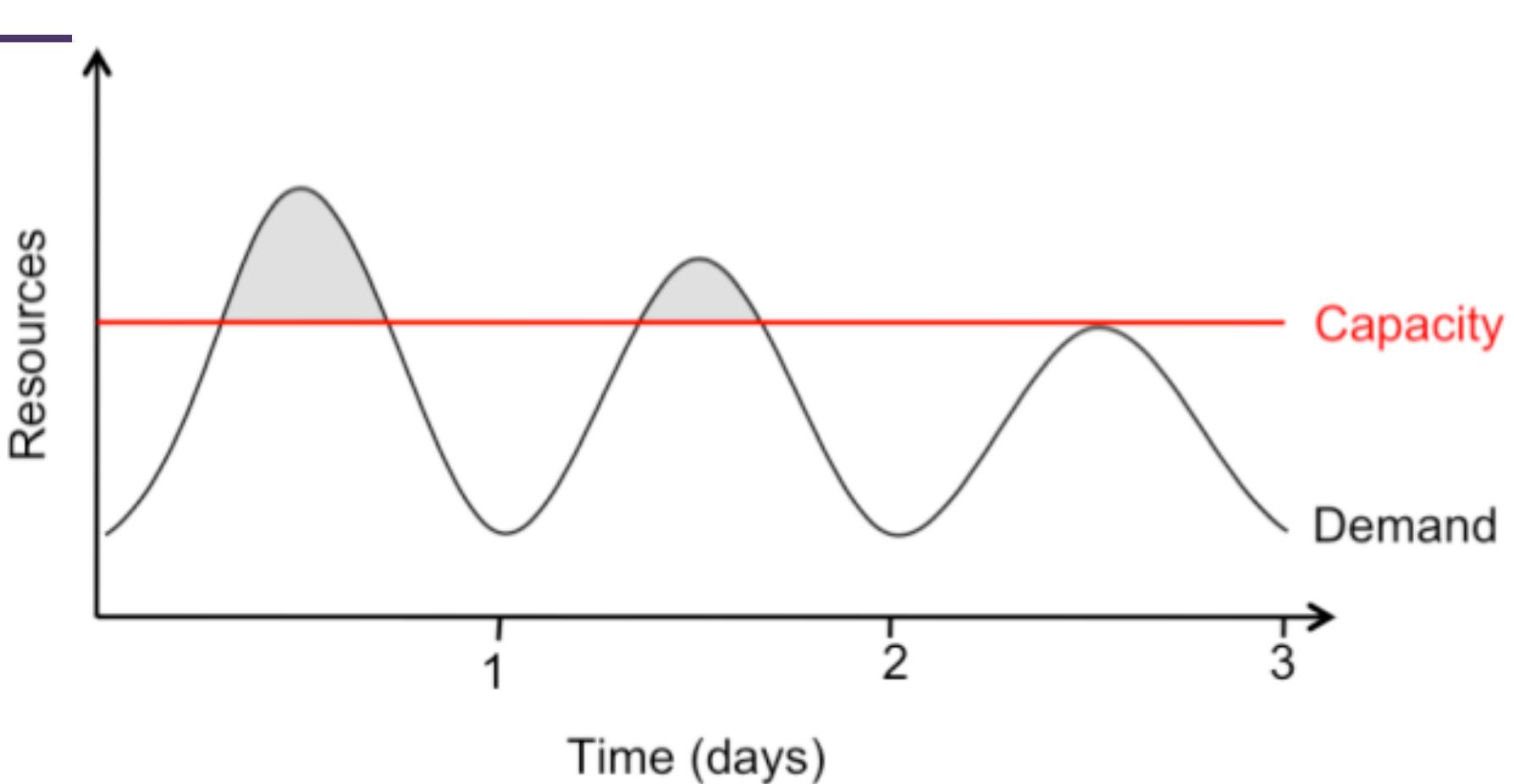
Provisioning for peak load

src: Armbrust et al., Above the Clouds: A Berkeley View of Cloud Computing, 2009



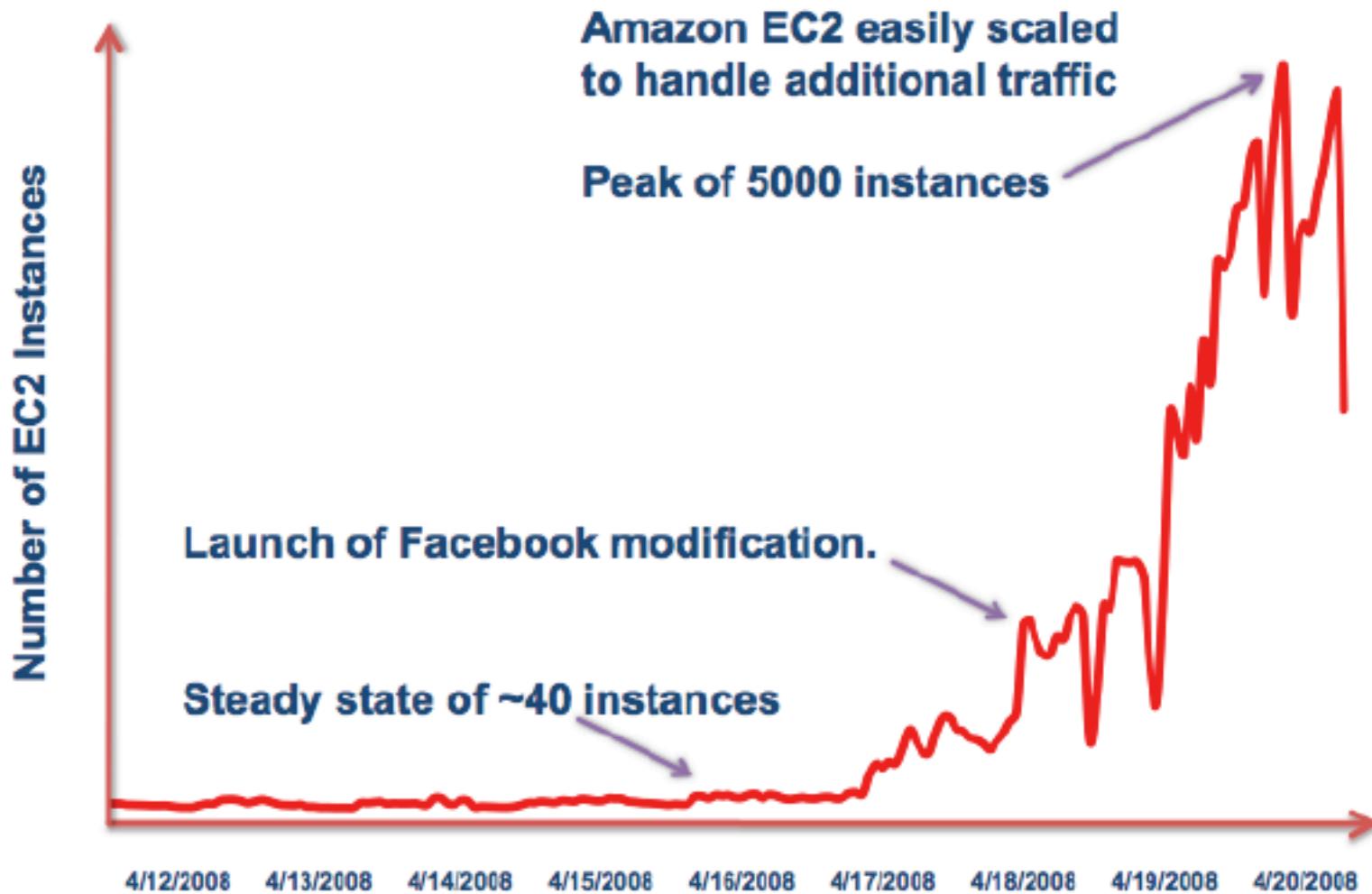
Underprovisioning

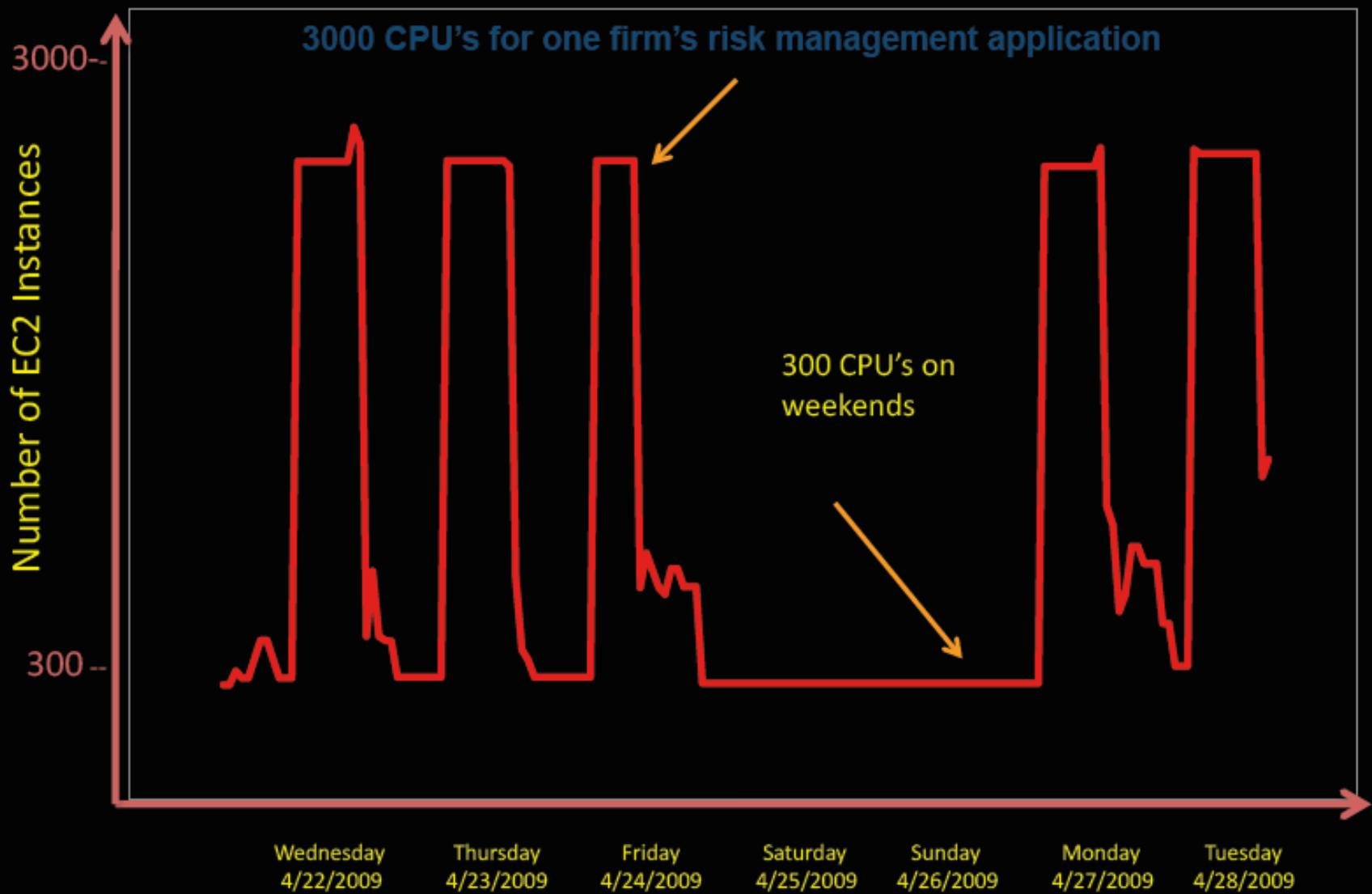
src: Armbrust et al., Above the Clouds: A Berkeley View of Cloud Computing, 2009



Underprovisioning, more realistic

src: Armbrust et al., Above the Clouds: A Berkeley View of Cloud Computing, 2009





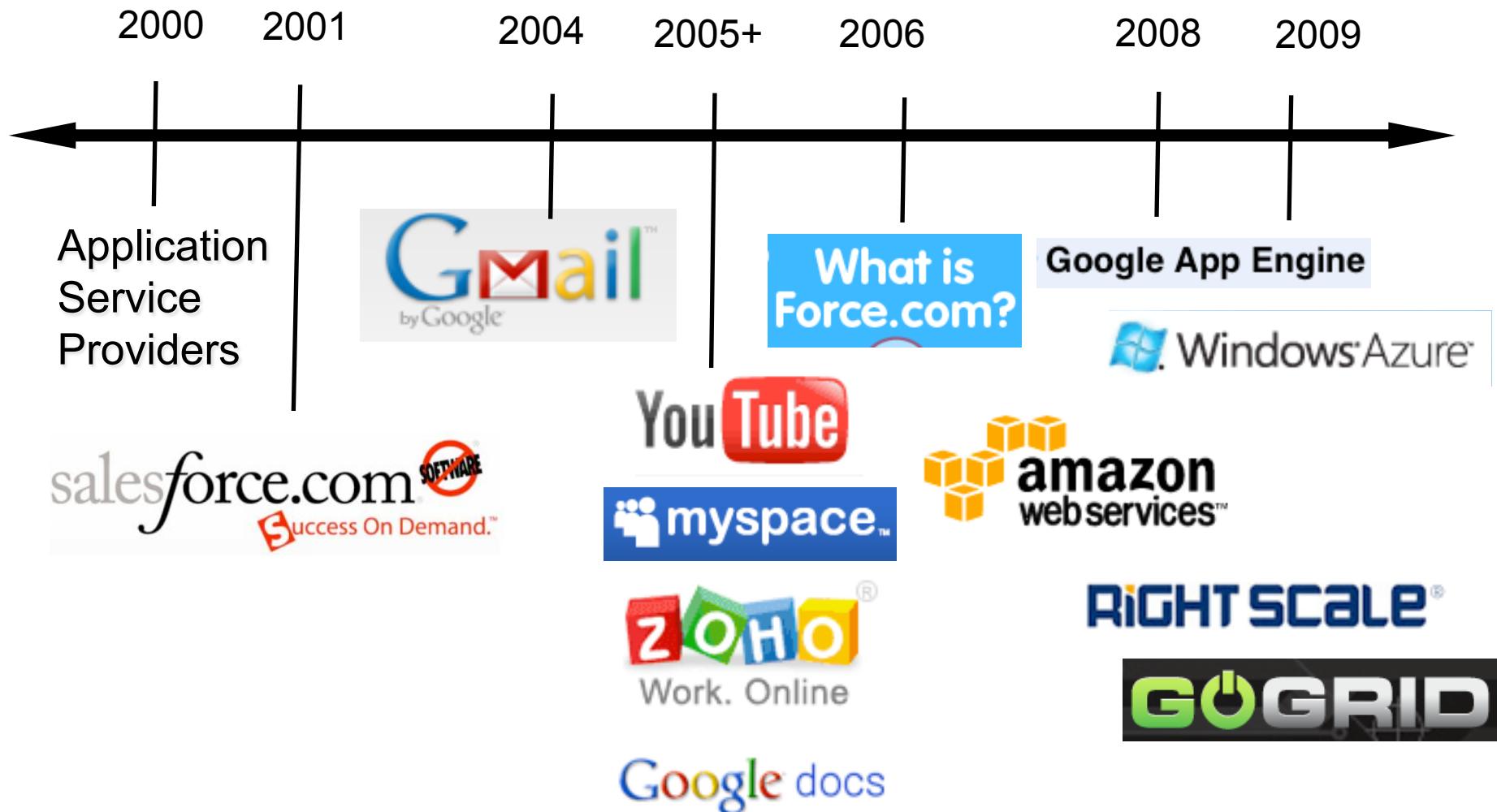
Bill H

[Deepak Singh, Amazon.com]

S3 growth

- 14 billion objects in January 2008
- 29 billion objects in October 2008
- 52 billion objects in March 2009
- 102 billion objects in March 2010
- 1 trillion objects in June 2012

History



Exemplars

- Software as a Service

 Google docs

- Platform as a Service

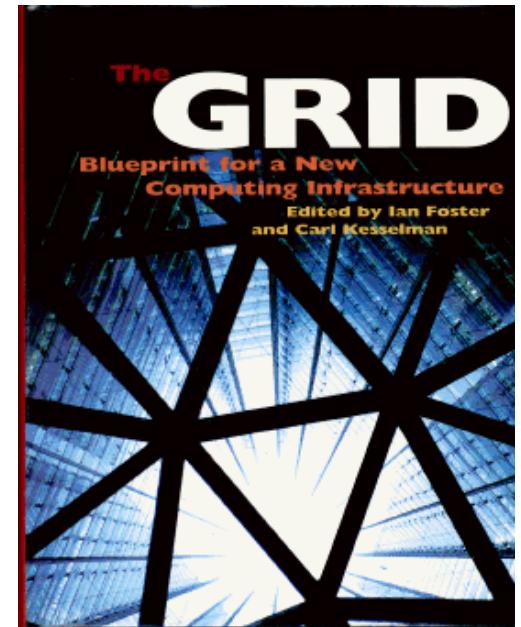
 Windows Azure

- Infrastructure as a Service

 amazon
web services™

Grid Computing

- Grid vs. Cloud
 - WAN vs. centralized
 - Heterogeneous vs. Data Center
 - Physical vs. Virtualized
 - Fewer, larger, dedicated allocations vs. more, smaller, shared allocations



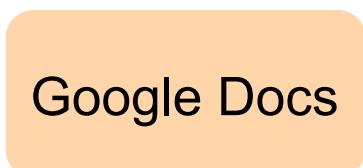
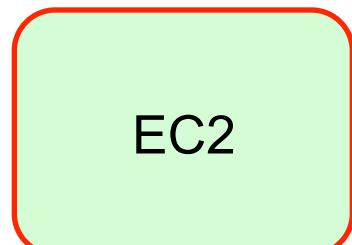
Foster 2002

Infrastructure-aaS

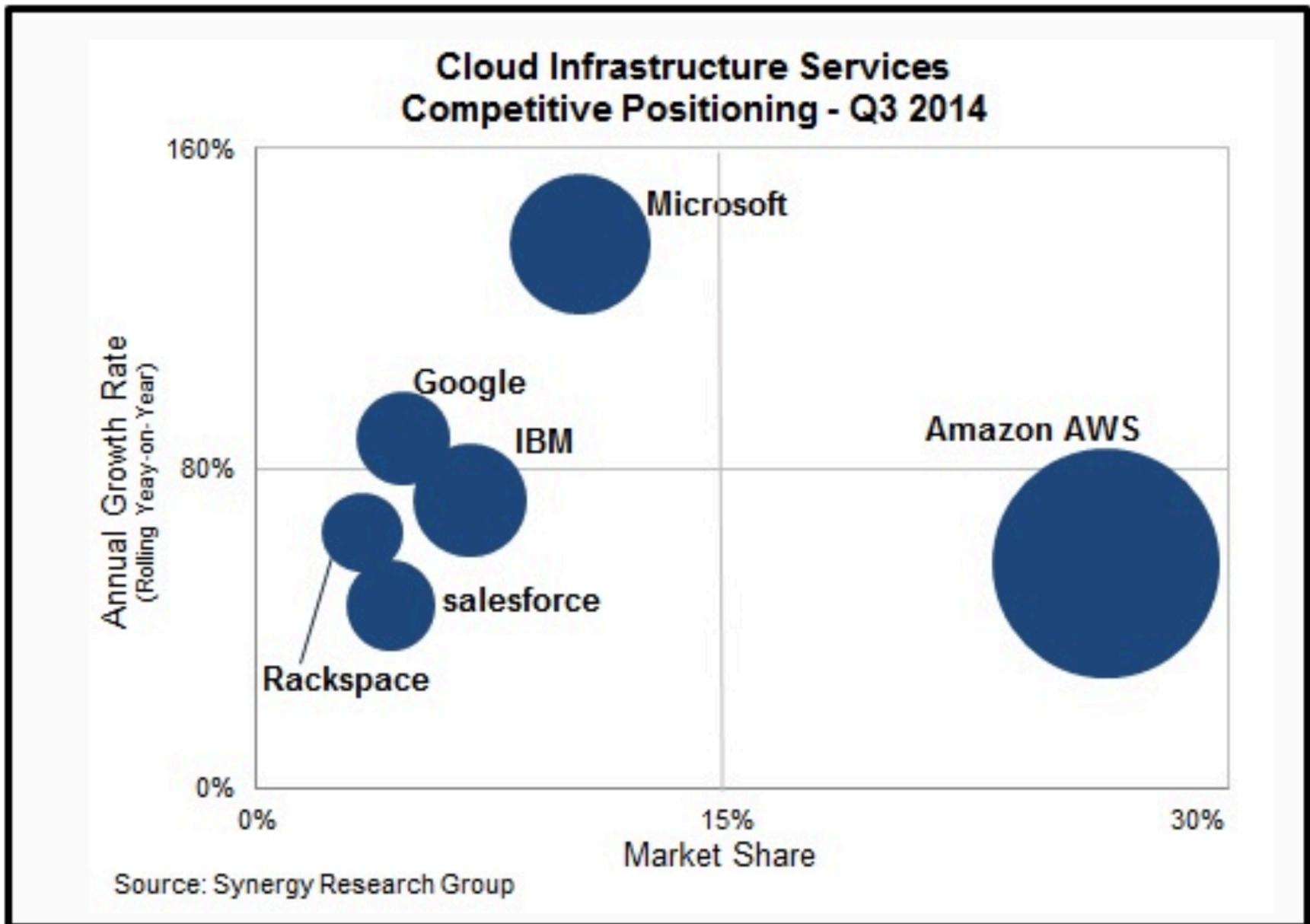
Platform-aaS

Software-aaS

Constrained



Automation





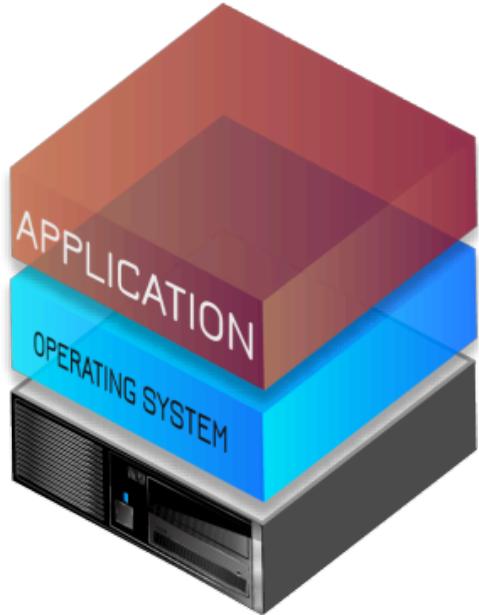
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AWS Data Center

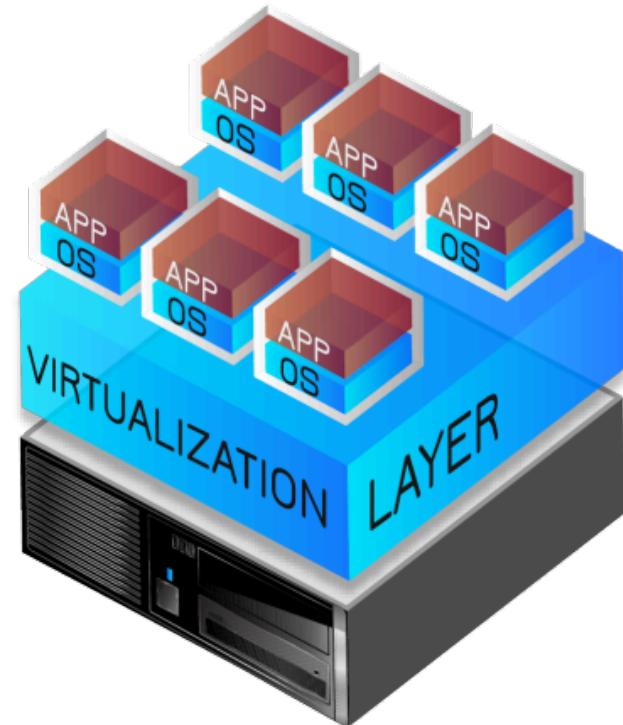
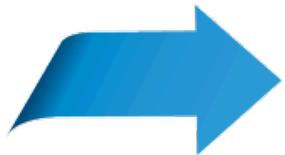




Key Concept: Virtualization



Traditional Architecture



Virtual Architecture

Why is this a good idea? Any downsides?

Class Exercise: Getting Started with EC2

1. Create your AWS account
2. Launch an EC2 Instance
3. Serve a web page from your instance
4. Host a static web page from S3