
Software Scalability and Cloud Computing

CS580 Advanced Software Engineering

<http://cs580.yusun.io>

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<http://yusun.io>

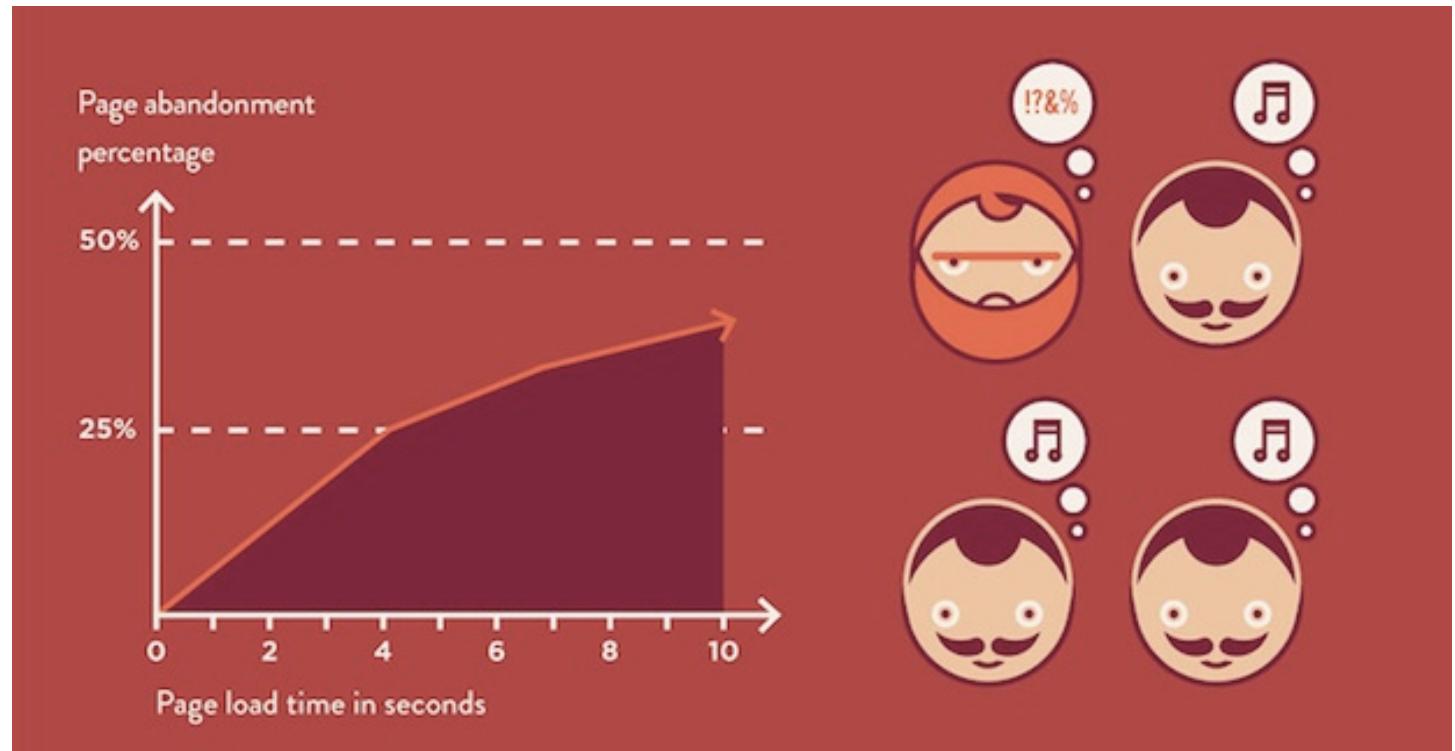
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CAL POLY POMONA

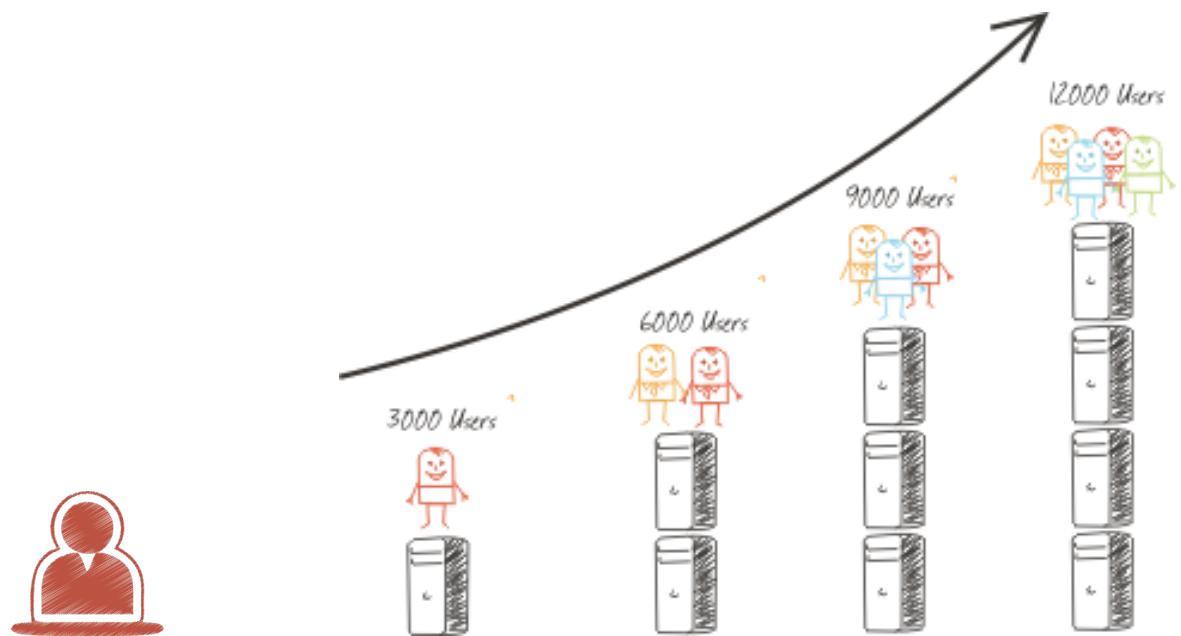
Amazon.com

- ◆ 426 items were sold per second during Christmas
- ◆ A page load slowdown of just one second could cost it \$1.6 billion in sales each year



Software Scalability

- ◆ *Scalability* is the ability of a system to handle a growing amount of work in a capable manner or its ability to be enlarged to accommodate that growth



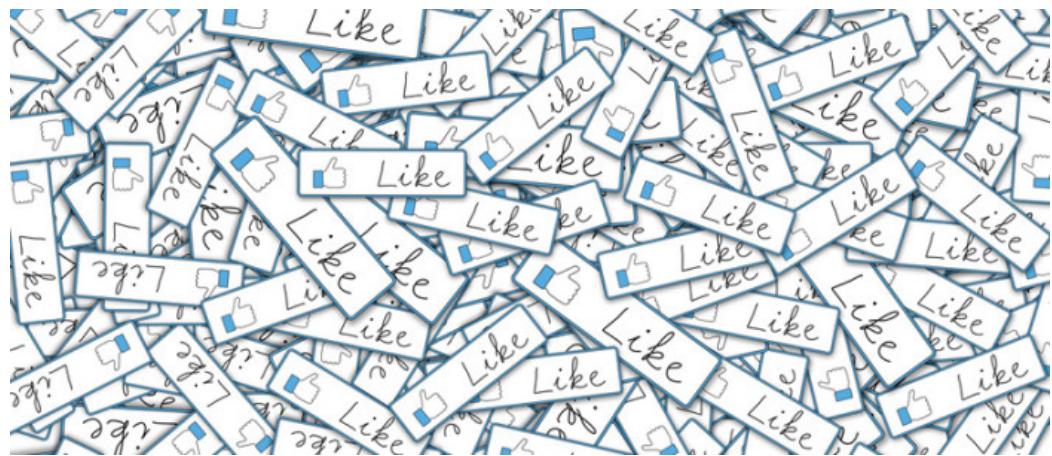
Google

- ◆ 3.5 billion searches / day
- ◆ 1.2 trillion searches / year



Facebook

- ◆ People spend over 700 billion minutes per month on Facebook
- ◆ In 20 minutes 10.2 million comments are posted
- ◆ 750 million photos were uploaded to Facebook over New Year's weekend

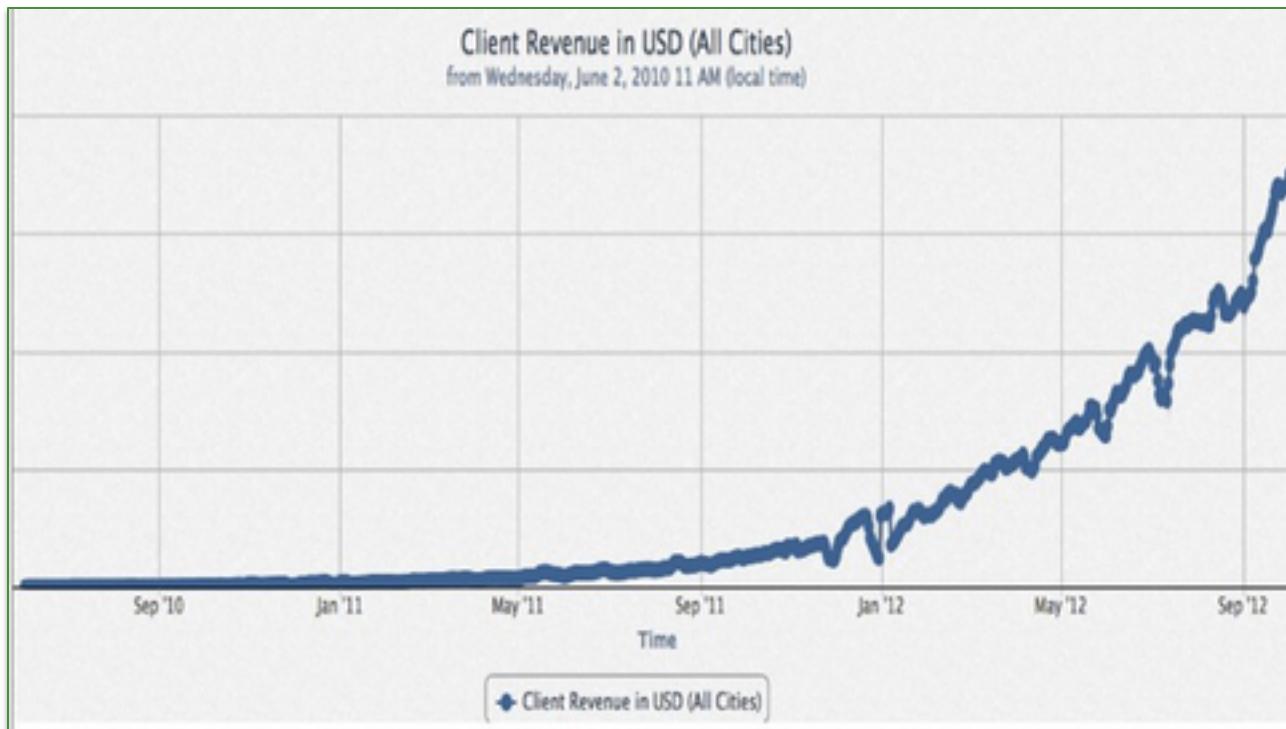


Amazon S3

- ◆ 1.3 trillion objects stored
- ◆ 1.1 million requests / second

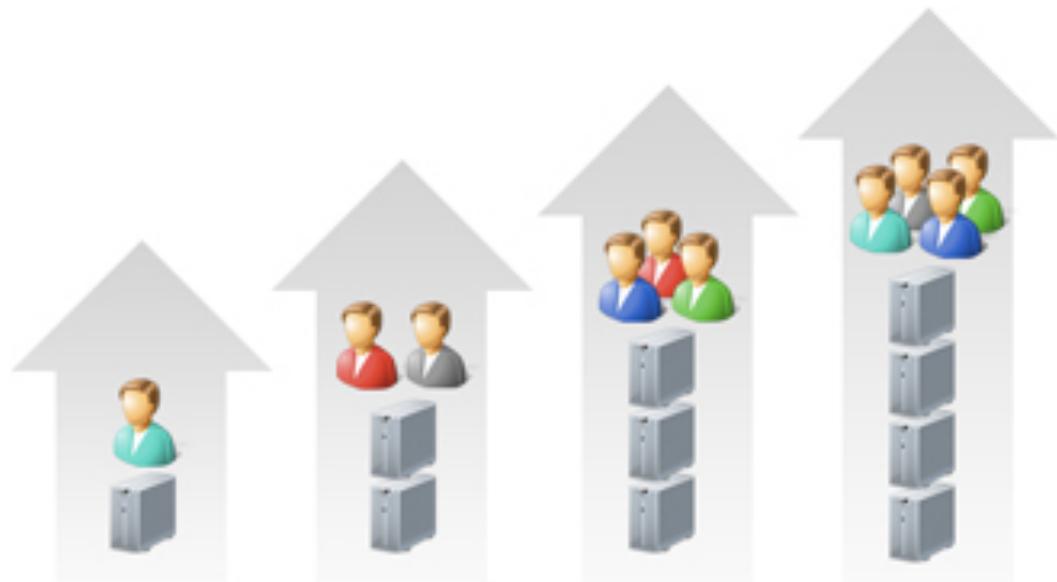


Uber Growth

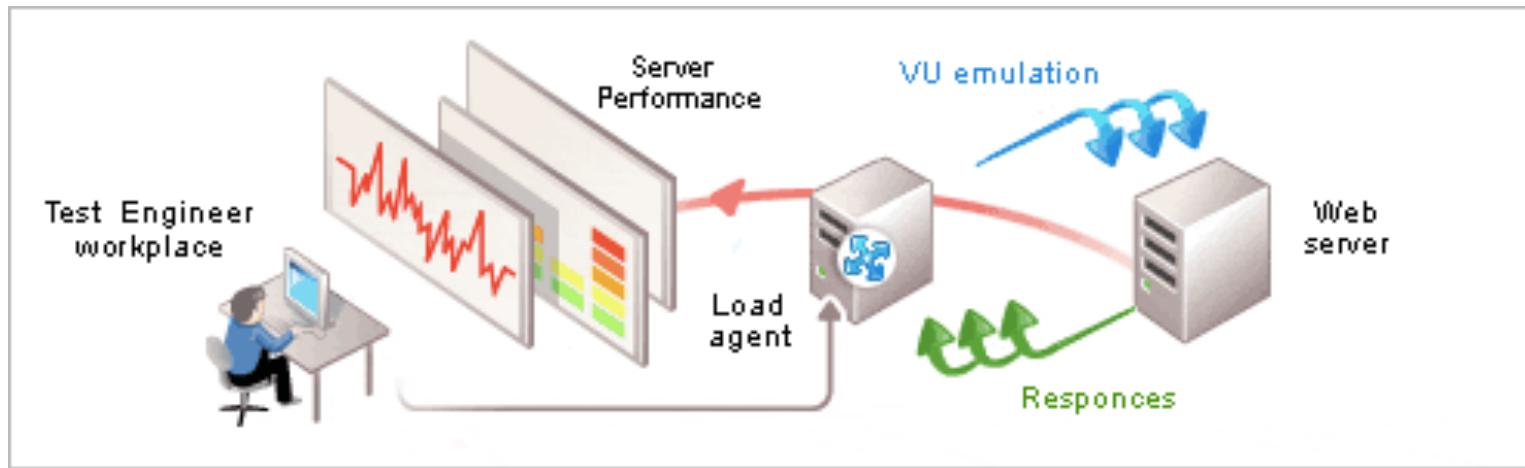


Always Keep Scalability in Mind

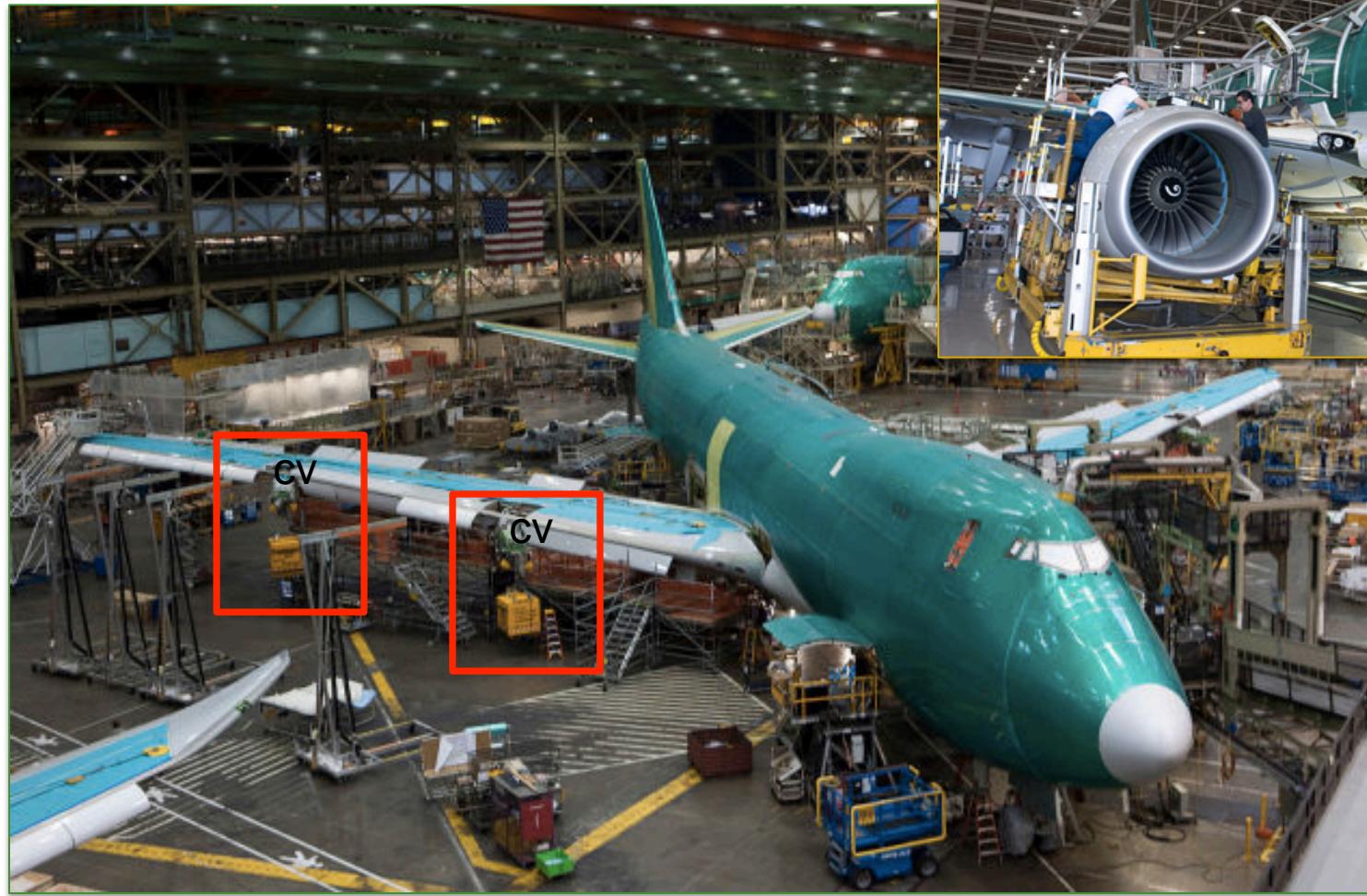
- ◆ Minimizing work
- ◆ Paging through large datasets
- ◆ Avoiding datastore contention
- ◆ Sharding counters
- ◆ Effective memcache



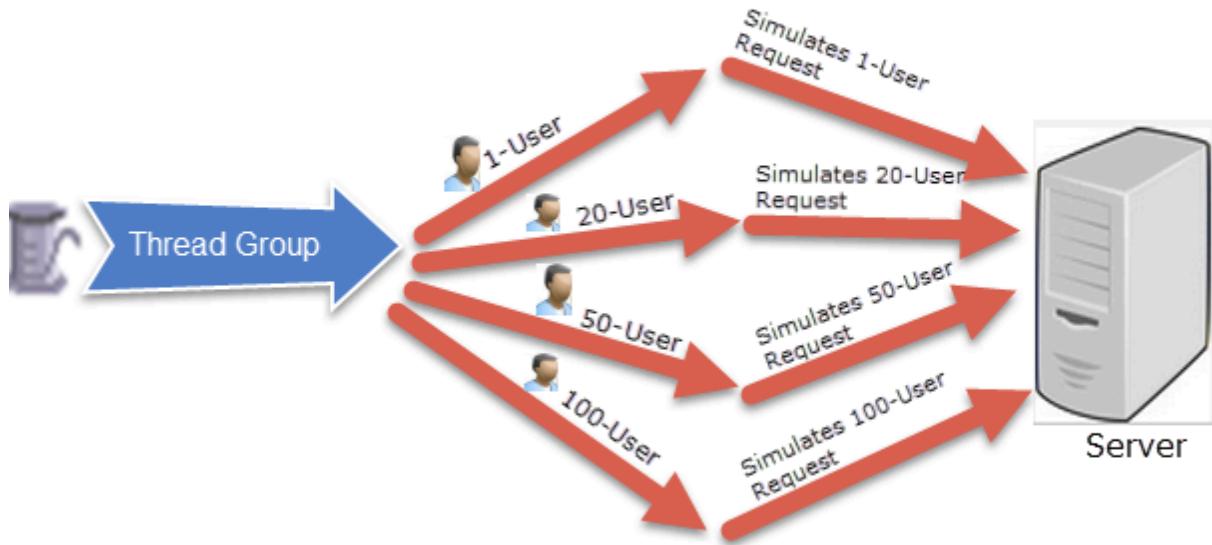
Scalability Verification – Load Test



Scalability Verification – Load Test



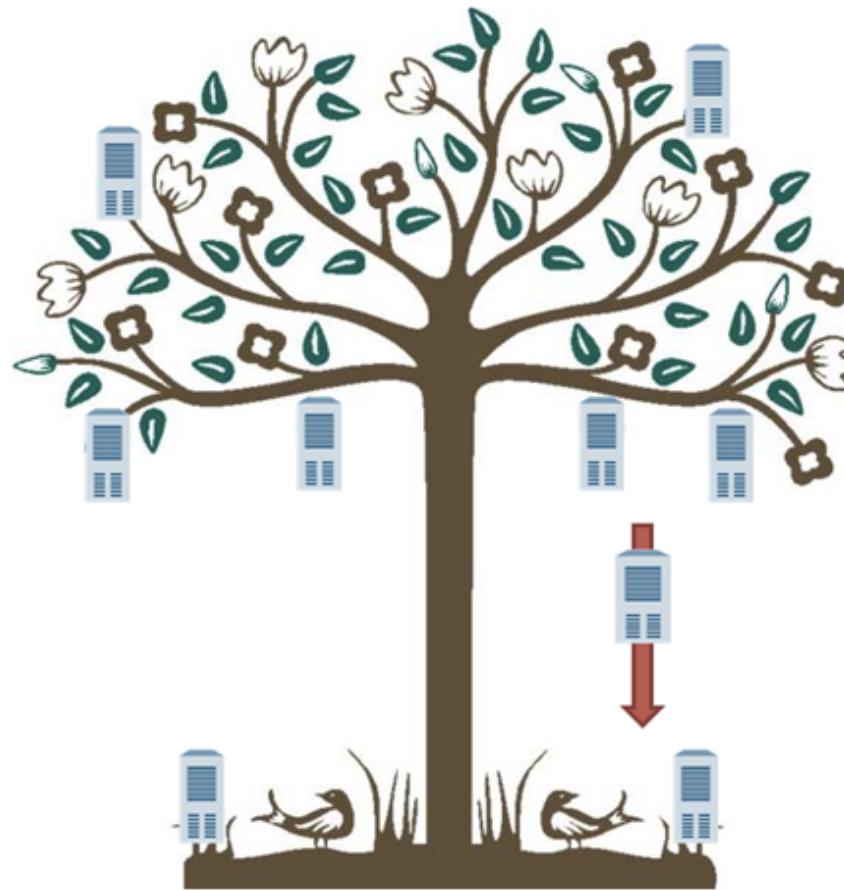
JMeter Demo



How to Improve Scalability?



How to Make Scalability Easy?



Cloud Computing

- ◆ Cloud computing shifts computing from local dedicated resources to distributed, virtual, elastic, multi-tenant resources
 - ◆ On-demand access to computing, storage, and software services
 - ◆ Based on a utility cost model



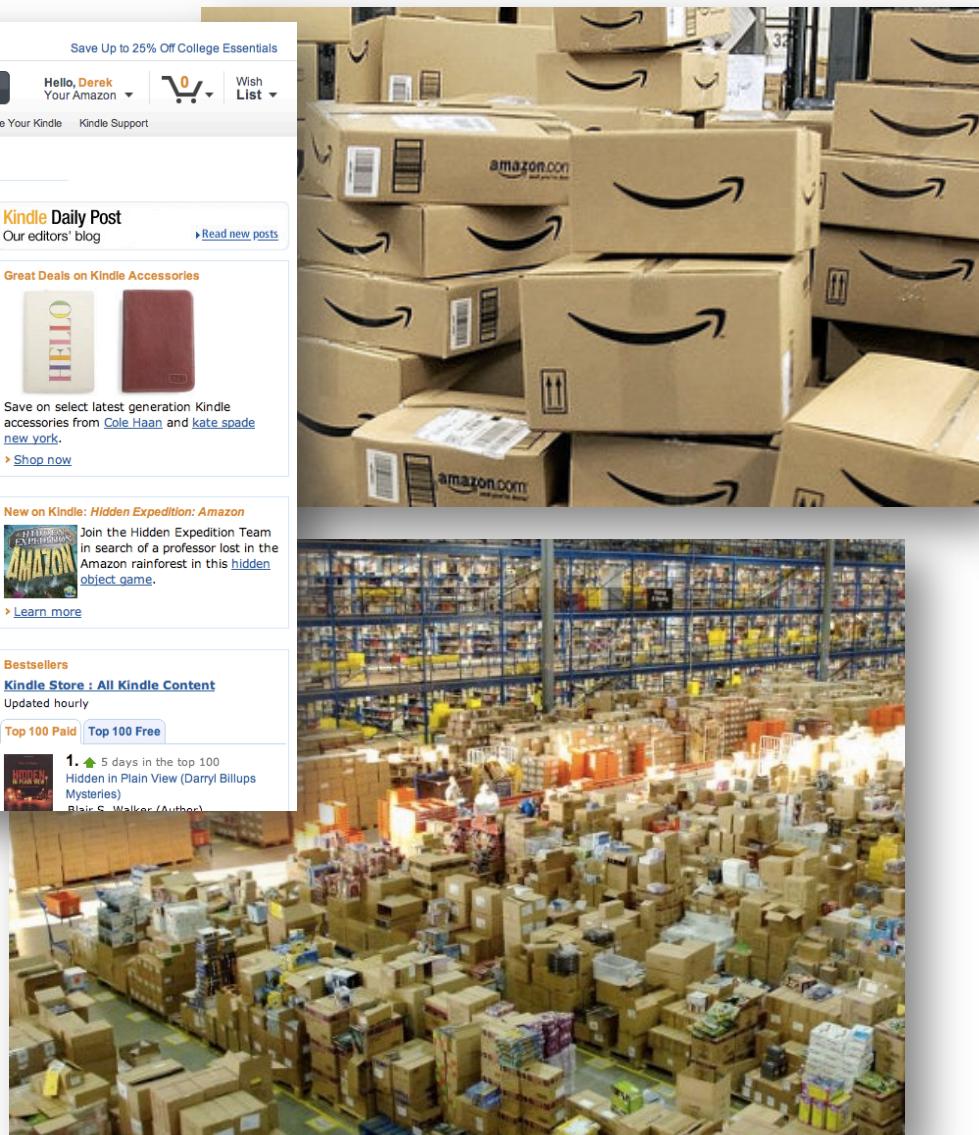
Cloud Computing & Amazon

- ◆ The popularization of the term can be traced to 2006 when Amazon.com introduced the Elastic Compute Cloud (EC2)



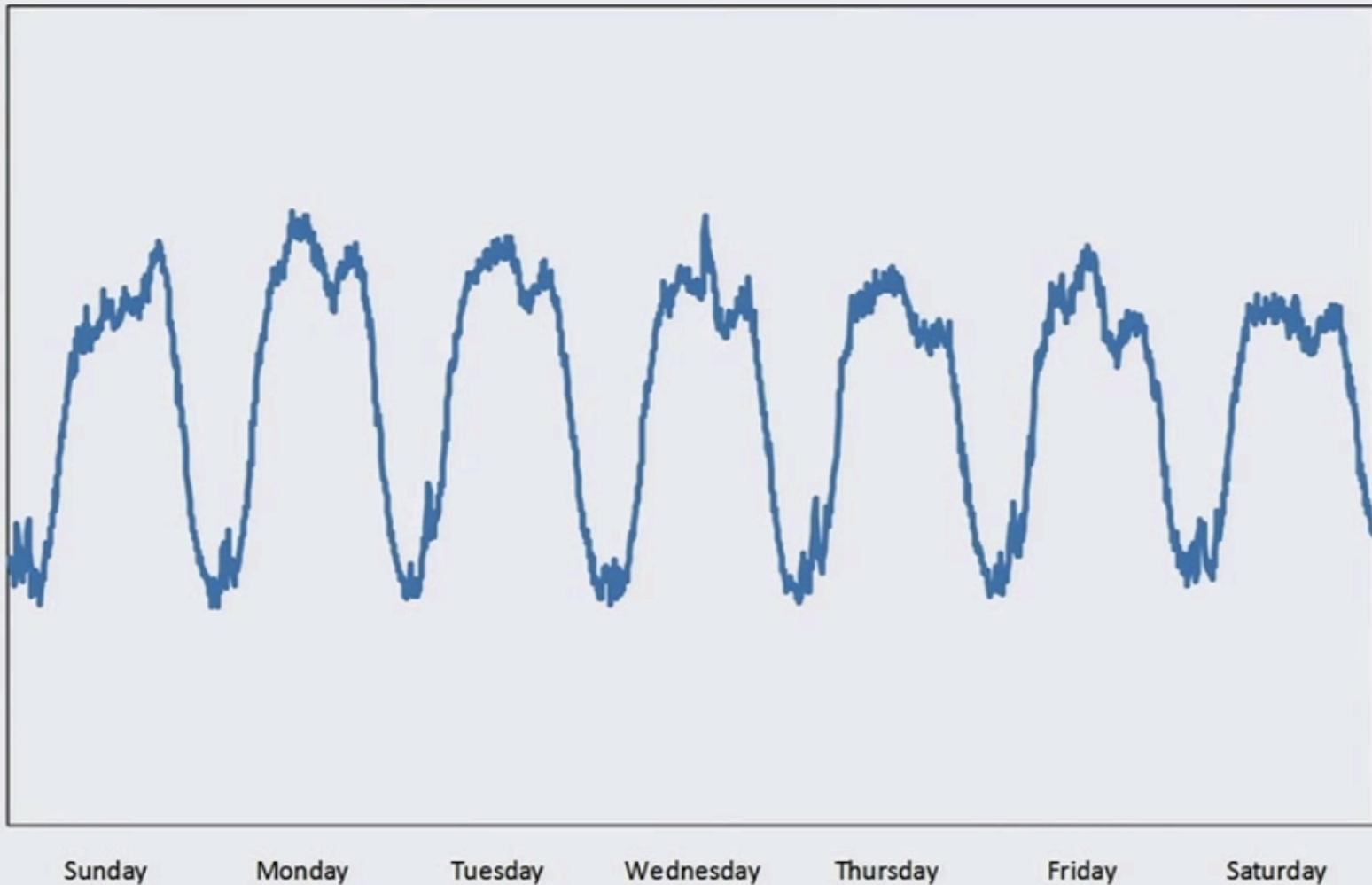
Case Study: Amazon Retail Website

The screenshot shows the Kindle Store page on the Amazon website. At the top, there's a navigation bar with links for 'Today's Deals', 'Gift Cards', and 'Help'. A search bar is positioned above a dropdown menu for 'Kindle Store'. To the right of the search bar, there are links for 'Hello, Derek', 'Your Amazon', a shopping cart icon, and a 'Wish List' dropdown. A banner at the top reads 'Save Up to 25% Off College Essentials'. Below the banner, a gold badge says 'Best of 2011' and 'Best Books of 2011 So Far' with a link to 'See all our editors' picks'. The main headline 'Kindle Store' is displayed in orange. Below it, text mentions Kindle (Wi-Fi, 6"), Kindle 3G (Free 3G + Wi-Fi, 6"), Accessories, and more than 950,000 Books, Kindle Singles, Newspapers, Magazines, Blogs, Audiobooks, and Games & Active Content. A large image of a Kindle device is shown with a price of '\$114' and a 'Order now' button. Below this, three Kindle models are listed: Kindle (\$139), Kindle 3G with Special Offers (\$139), and Kindle 3G (\$189). A section titled 'More Items to Consider' shows book covers for 'THE INNOVATOR'S DNA', 'BASIC ECONOMICS', 'The Innovator's Dilemma', and 'venture deals'. On the left sidebar, there are sections for 'Your Country or Region (What's this?)' set to 'United States', 'Browse' (listing Kindle models like Kindle DX and Kindle for iPad), 'Kindle Reading Apps' (listing Kindle Cloud Reader and Kindle for iPhone), and 'Give Kindle Gifts' (listing Kindle Books and Kindle Gift Cards). There are also 'Need Help?' links for Getting Started, Manage Your Kindle, Kindle Support, Around the Store, and Kindle Singles.



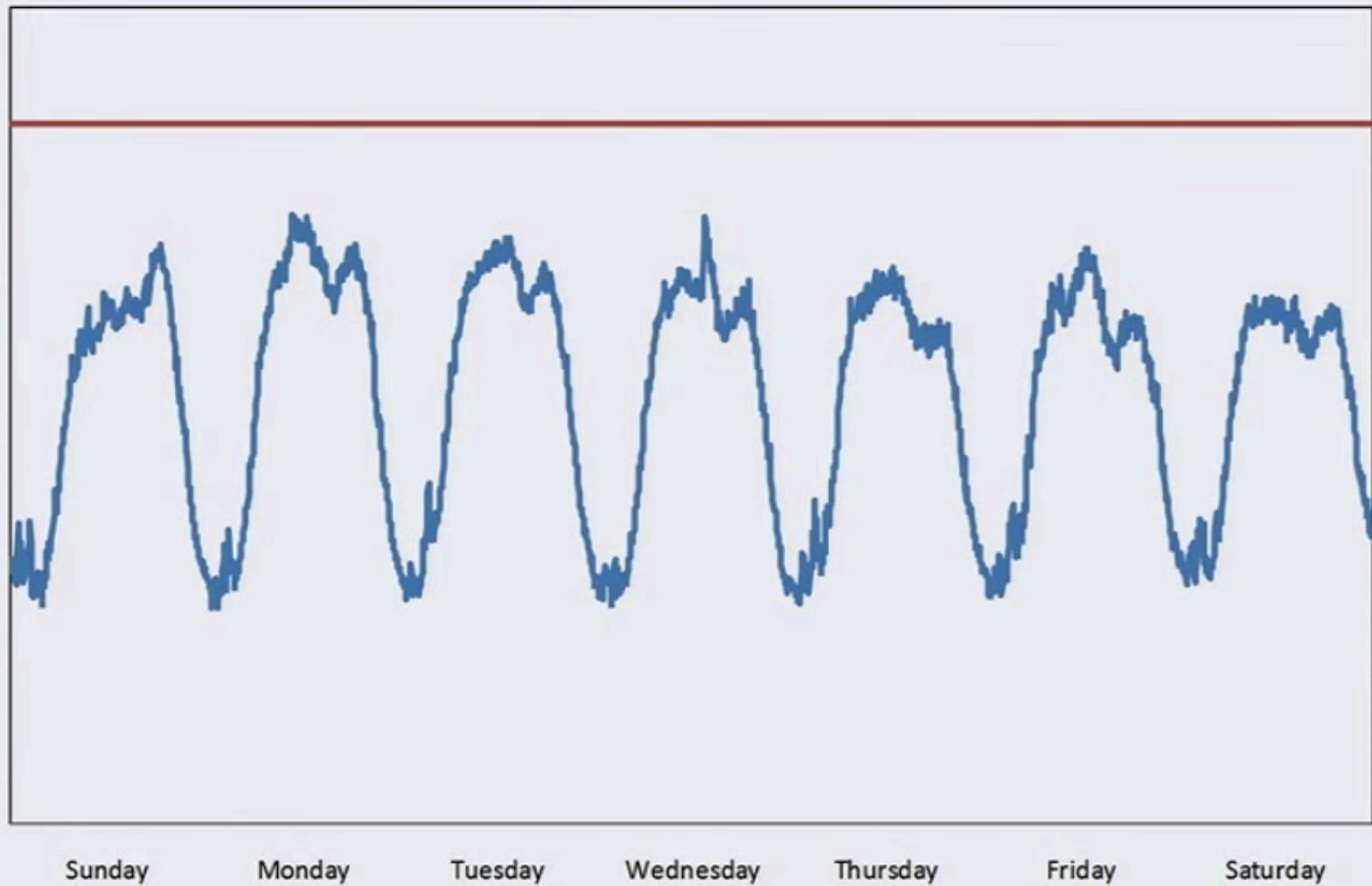
Case Study: Amazon Retail Website

Typical Weekly Traffic to amazon.com



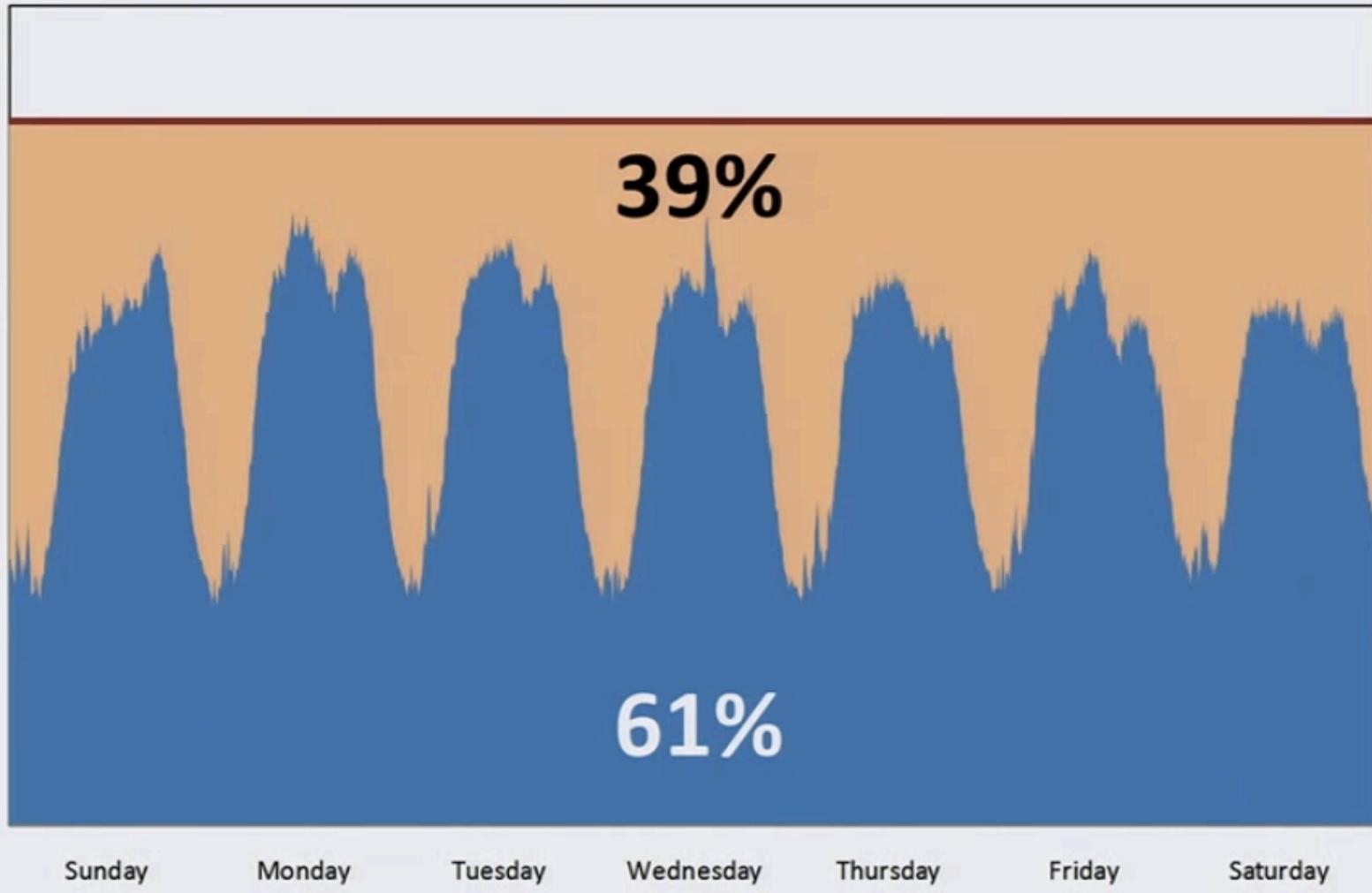
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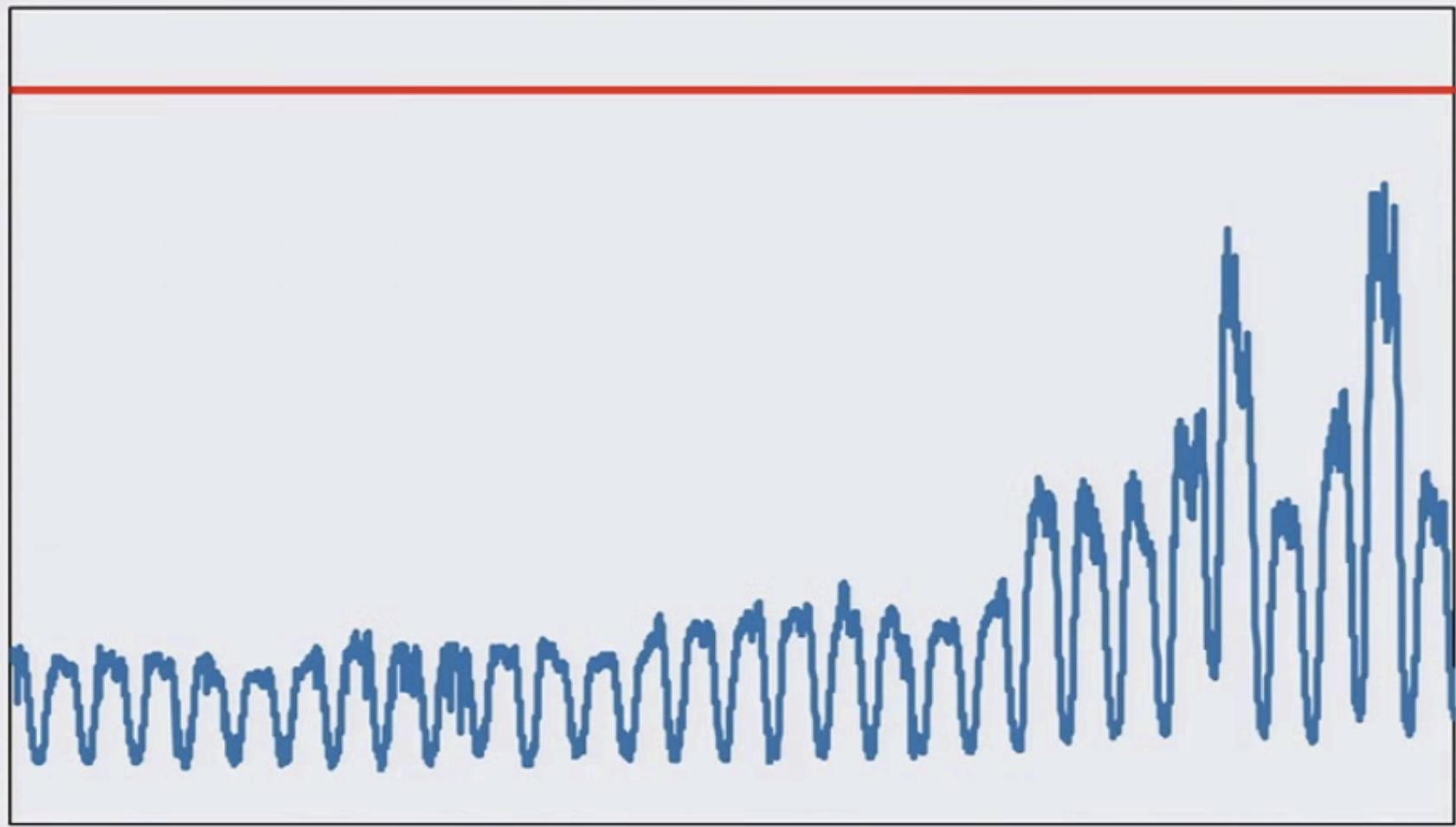
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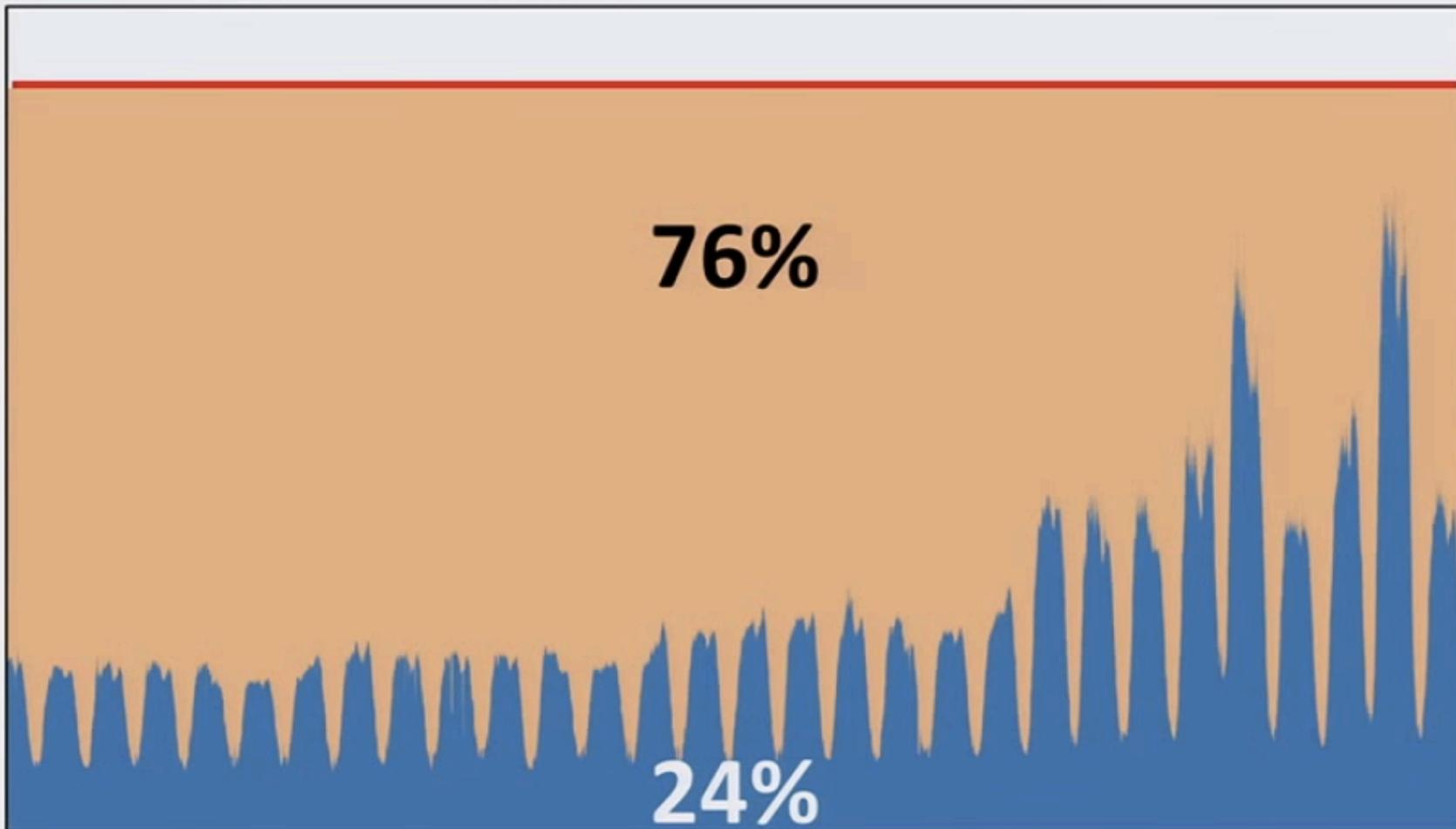
Case Study: Amazon Retail Website

November Traffic for amazon.com



Case Study: Amazon Retail Website

November Traffic for amazon.com



76%

24%

Motivation of Cloud Computing (I)

November Traffic for amazon.com



Capacity Planning = Spending Money

Capacity Optimization = Saving Money



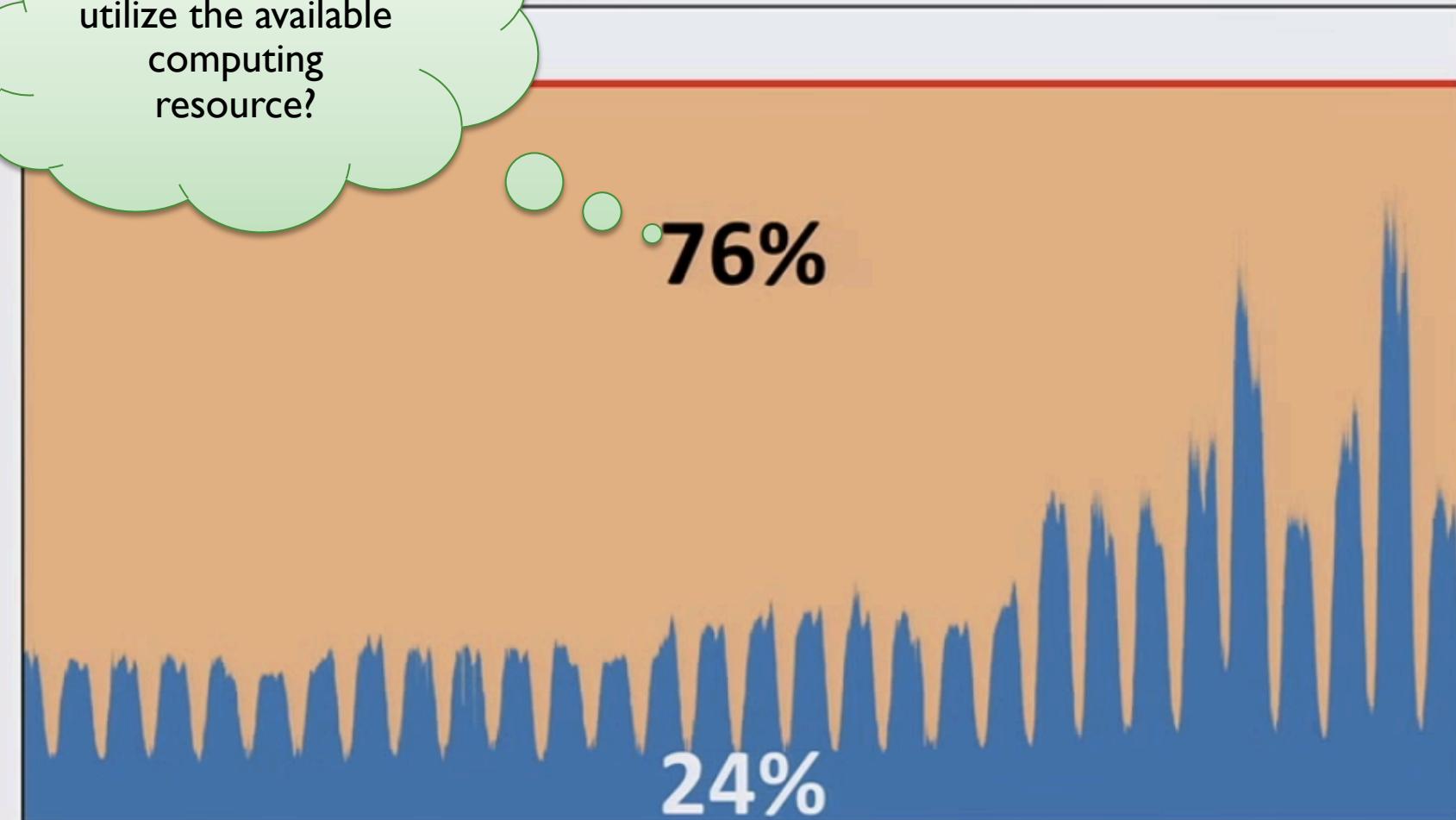
Motivation of Cloud Computing (2)

How can we better utilize the available computing resource?

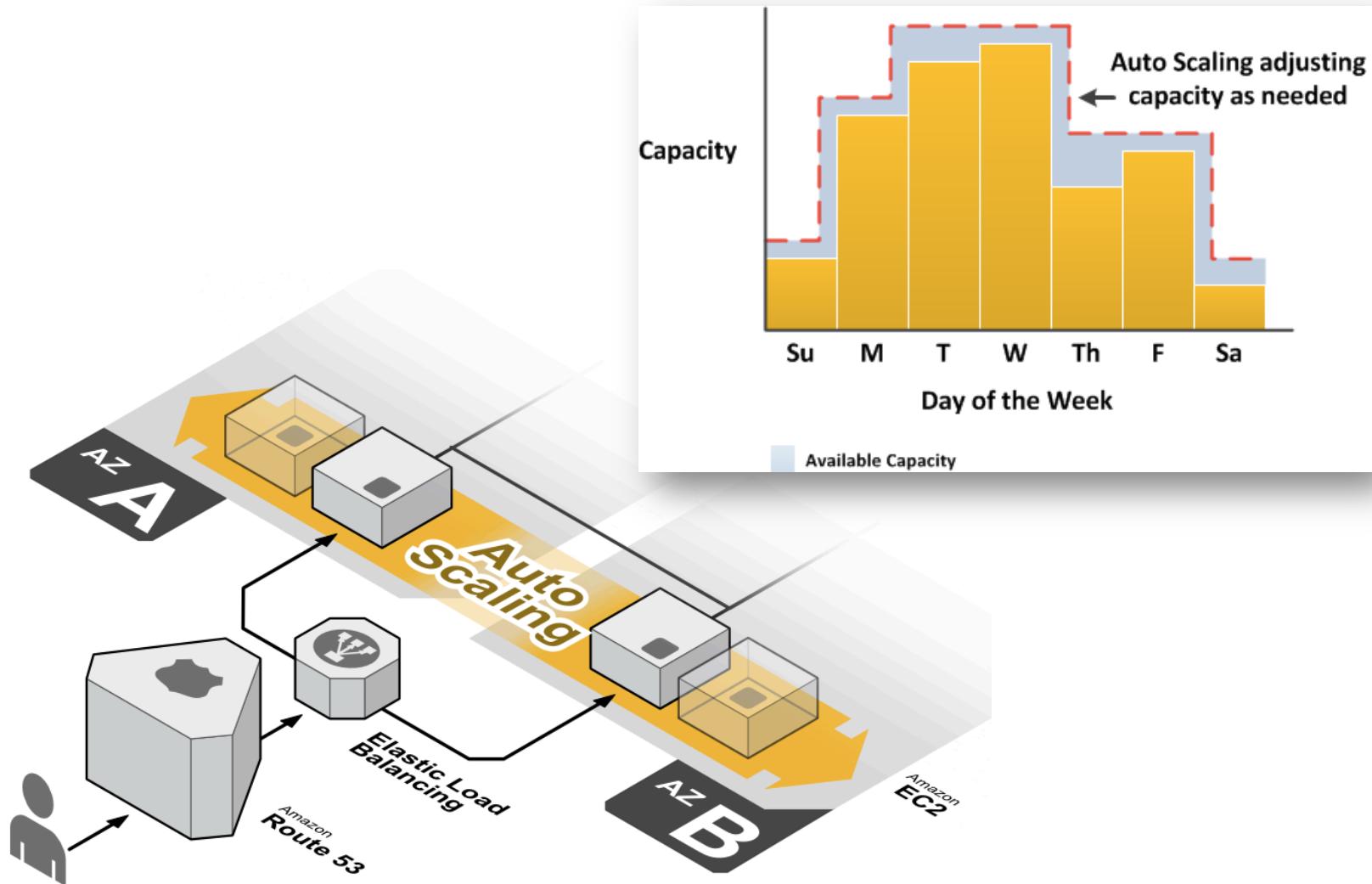
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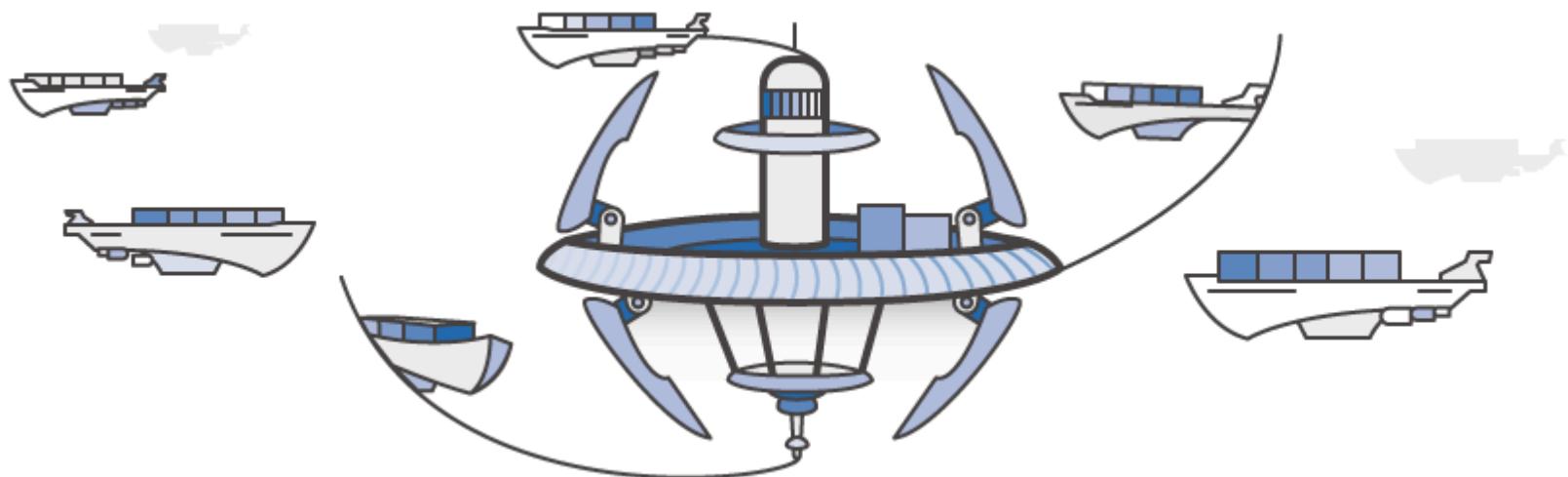


Amazon EC2 Infrastructure



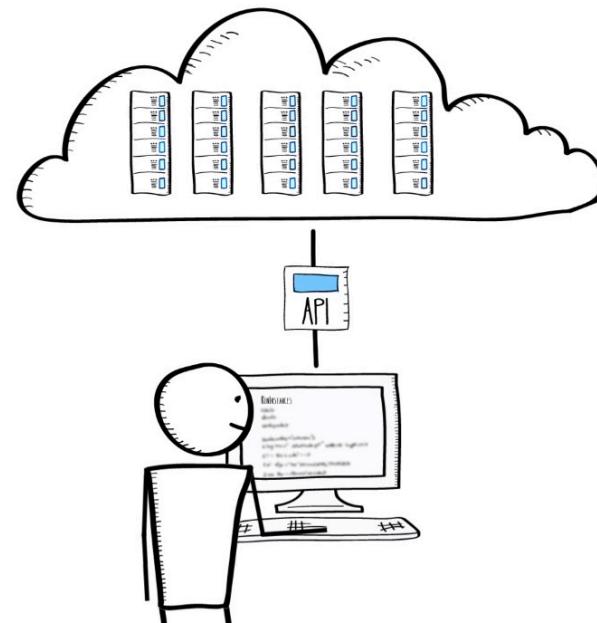
Amazon EC2 On-Demand Pricing

United States	Europe	
Standard On-Demand Instances	Linux/UNIX Usage	Windows Usage
Small (Default)	\$0.10 per hour	\$0.125 per hour
Large	\$0.40 per hour	\$0.50 per hour
Extra Large	\$0.80 per hour	\$1.00 per hour
High CPU On-Demand Instances	Linux/UNIX Usage	Windows Usage
Medium	\$0.20 per hour	\$0.30 per hour
Extra Large	\$0.80 per hour	\$1.20 per hour

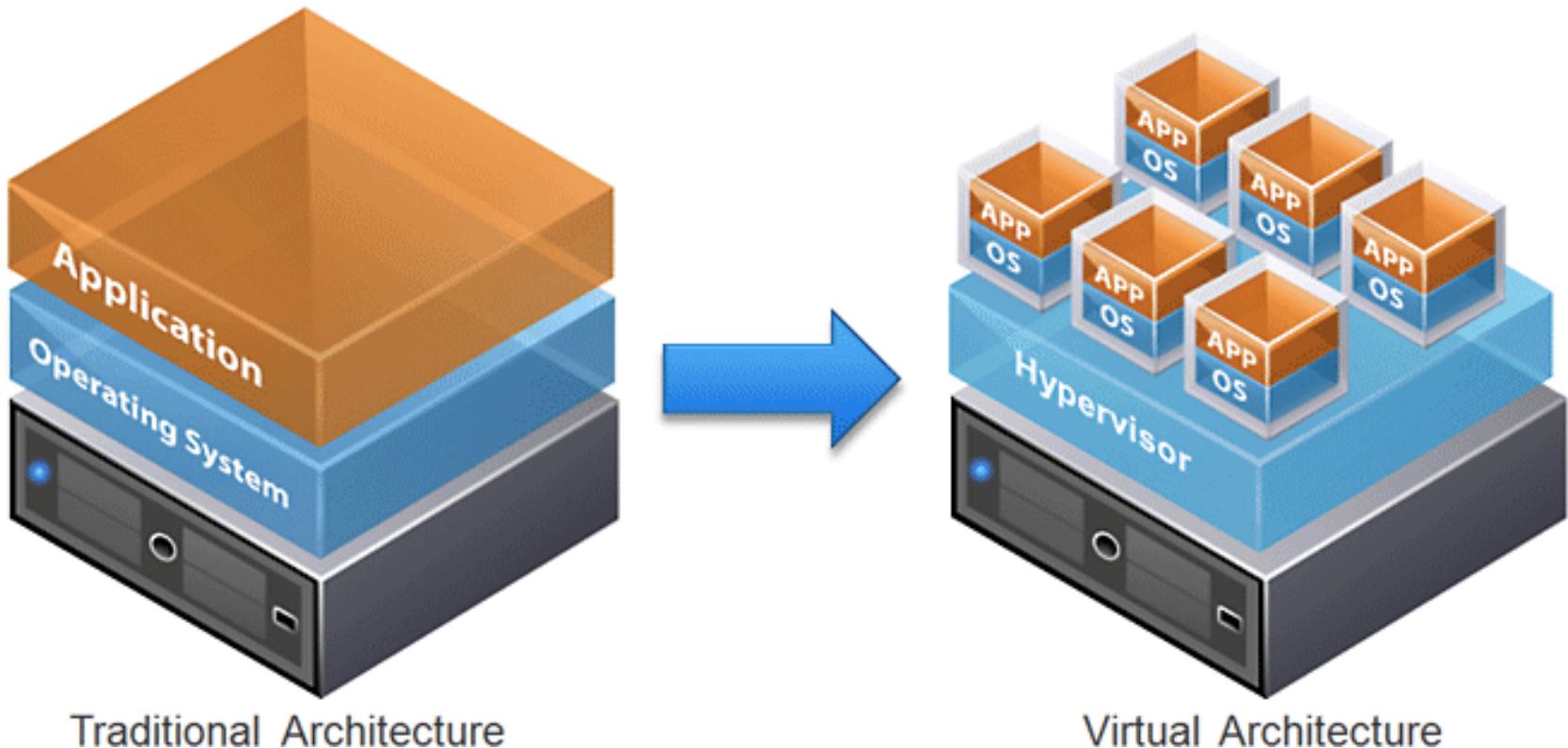


Amazon.com is Fully Served by EC2

- ◆ Reduced spending on server capacity
- ◆ Fleet scales dynamically in increments as small as a single host
- ◆ Traffic spikes can be handled with ease
- ◆ Cultural change



Virtualization

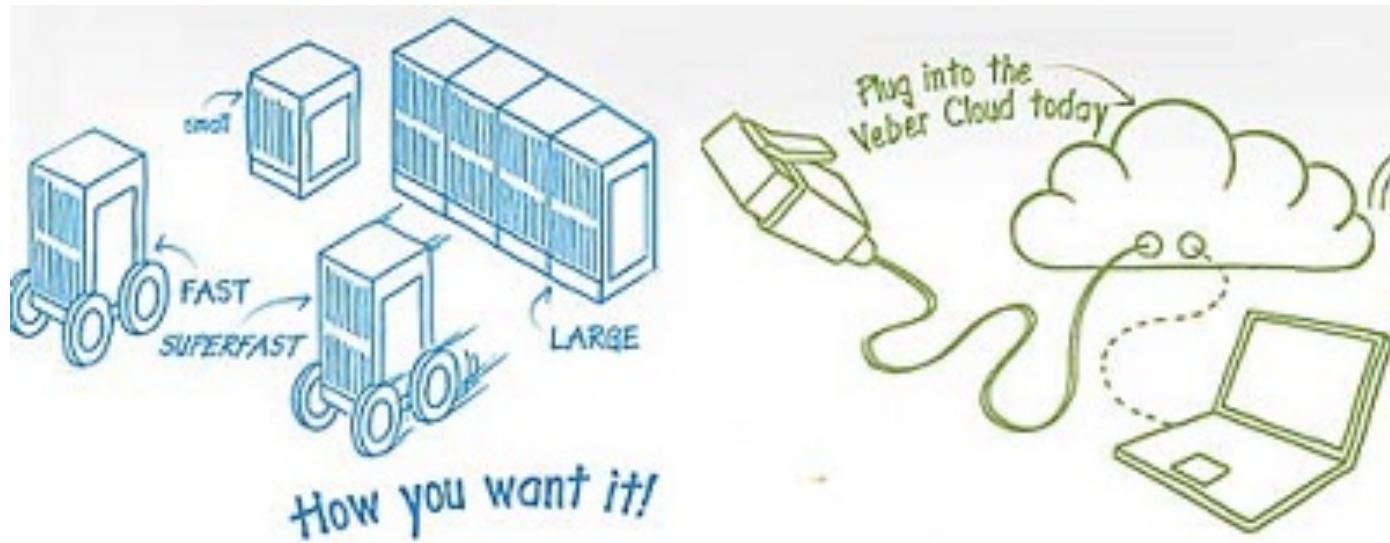


Flexible Options

Google vs. AWS On-Demand Pricing

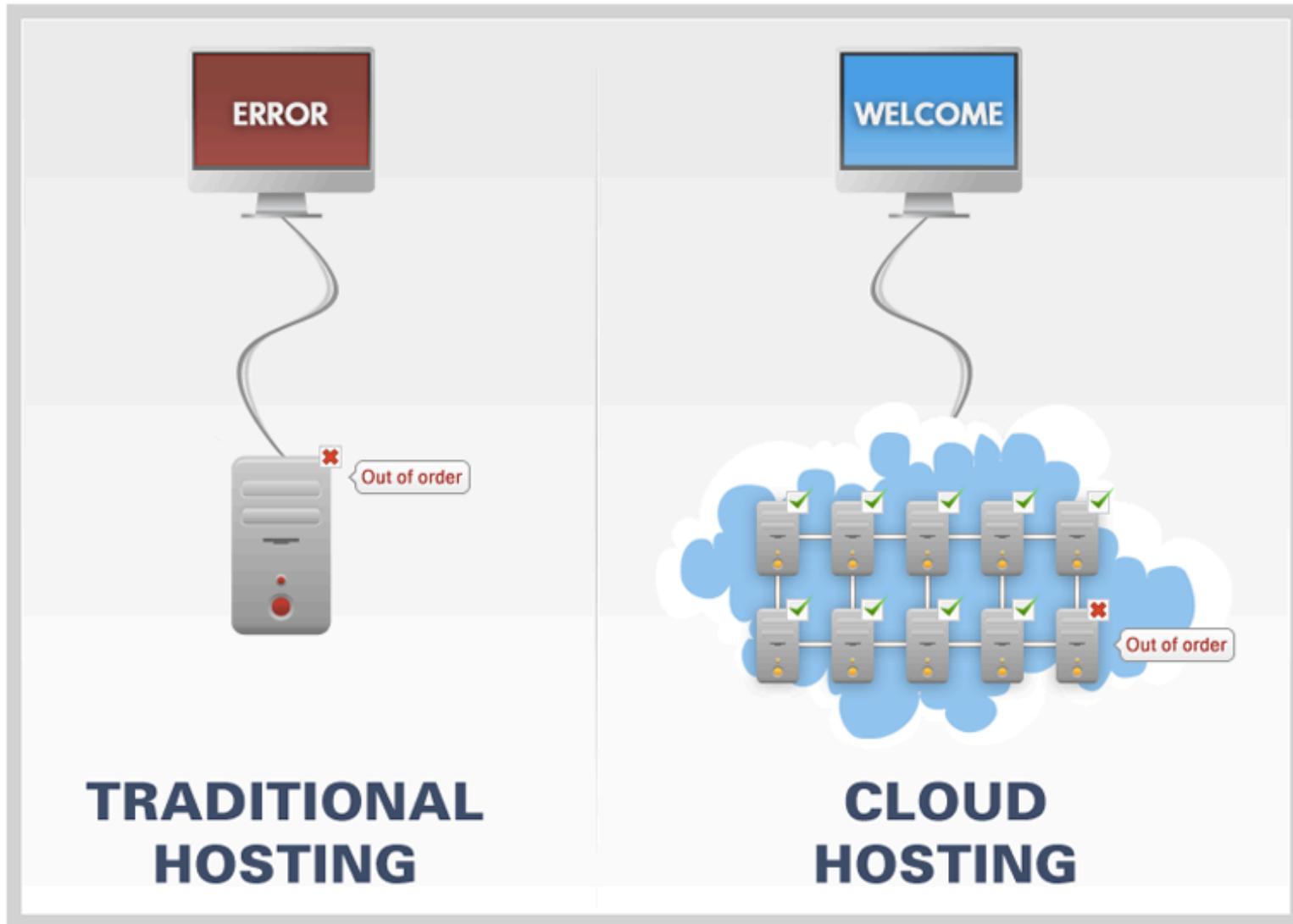
Google Instance Type	CPU Cores	RAM	AWS Instance Type	CPU Cores	RAM	Google New On-Demand (per hour)	AWS On-Demand (per hour)	New Google Price vs. AWS
n1-standard-1	1	3.75	m3.medium	1	3.75	\$ 0.070	\$ 0.113	-38.05%
n1-standard-2	2	7.5	m3.large	2	7.5	\$ 0.140	\$ 0.225	-37.78%
n1-standard-4	4	15	m3.xlarge	4	15	\$ 0.280	\$ 0.450	-37.78%
n1-standard-8	8	30	m3.2xlarge	8	30	\$ 0.560	\$ 0.900	-37.78%
n1-higmem-2	2	13	m2.xlarge	2	17.1	\$ 0.164	\$ 0.410	-60.00%
n1-higmem-4	4	26	m2.2xlarge	4	34.2	\$ 0.328	\$ 0.820	-60.00%
n1-higmem-8	8	52	m2.4xlarge	8	68.4	\$ 0.656	\$ 1.640	-60.00%
n1-highcpu-2	2	1.8	c3.large	2	3.75	\$ 0.088	\$ 0.150	-41.33%
n1-highcpu-4	4	3.6	c3.xlarge	4	7.5	\$ 0.176	\$ 0.300	-41.33%
n1-highcpu-8	8	7.2	c3.2xlarge	8	15	\$ 0.352	\$ 0.600	-41.33%
n1-highcpu-16	16	14.4	c3.4xlarge	16	30	\$ 0.704	\$ 1.200	-41.33%

Rapid Resource Allocation

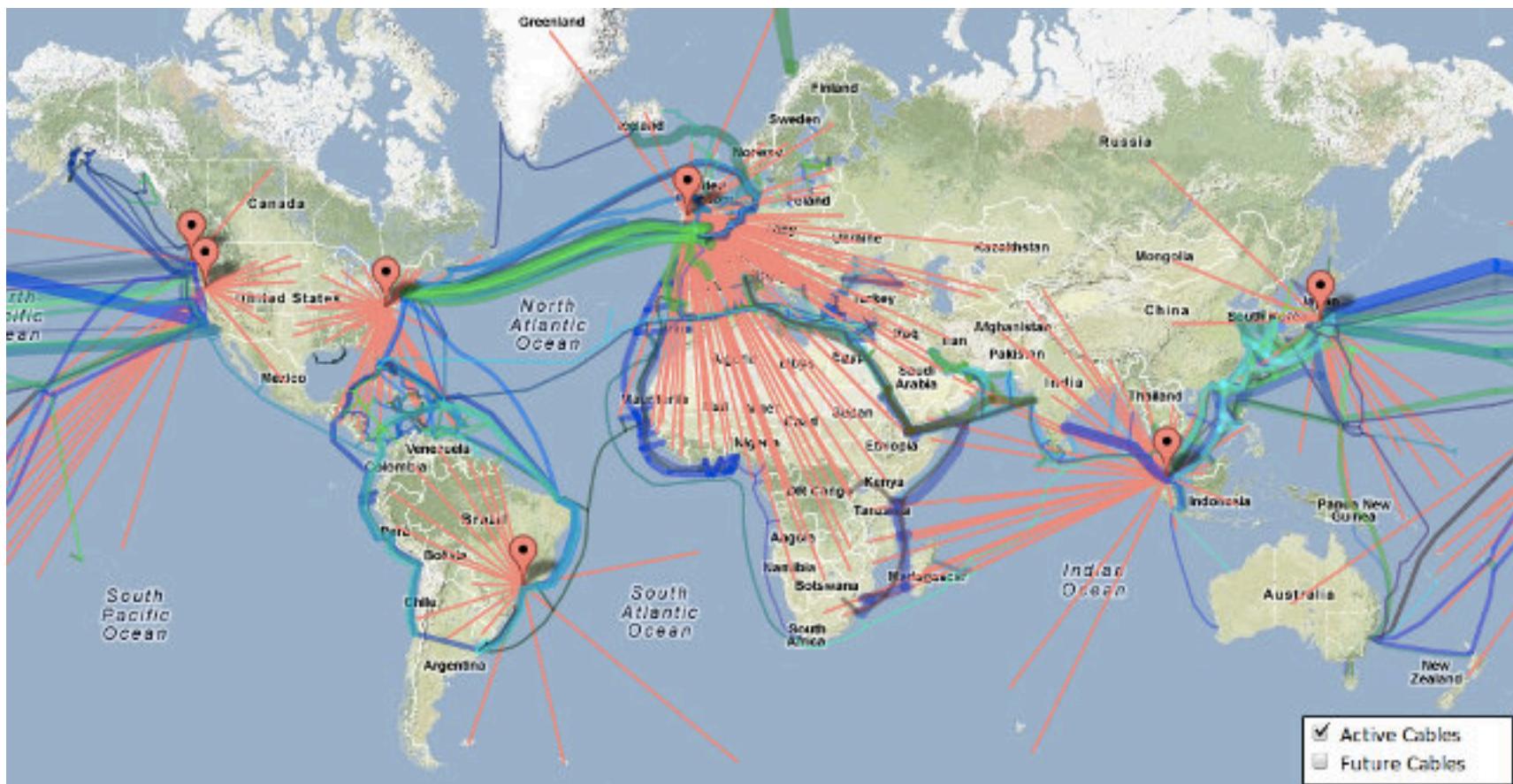


Dedicated Vs Cloud

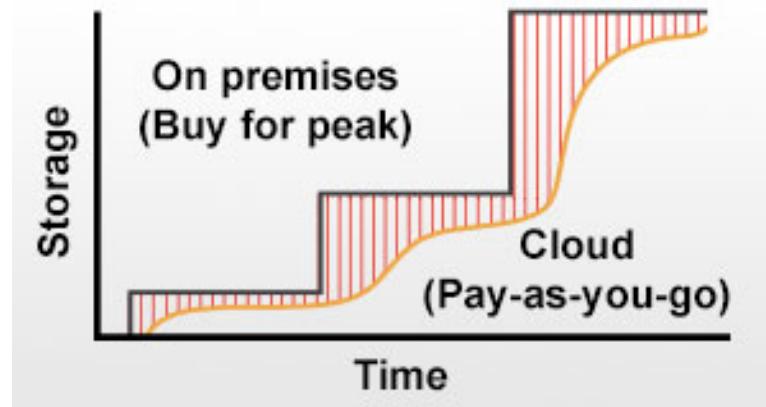
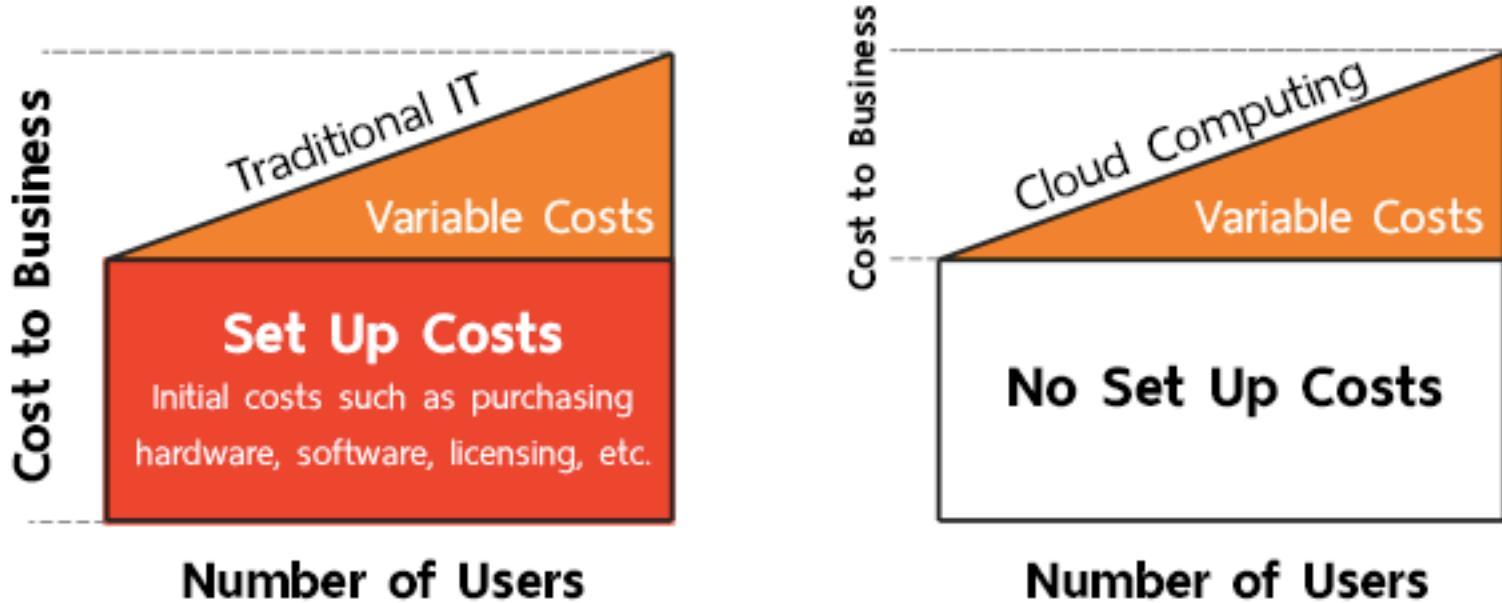
High Availability



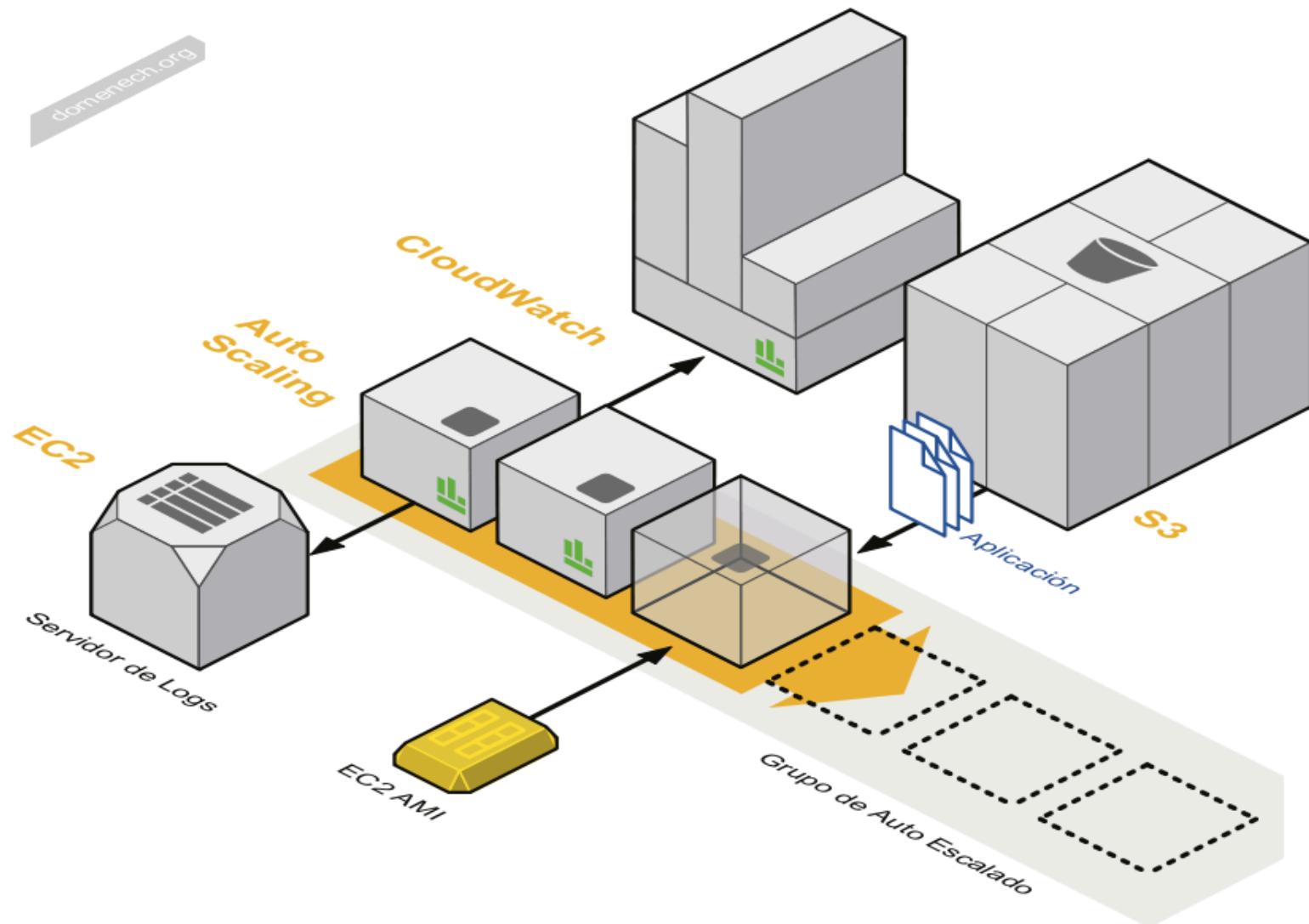
High Availability: AWS Data Centers



Cost-Effective



Scalability: Auto-Scaling



Auto-Scaling Demo



Focus on the Applications



Startups Made Easy



Etsy



Deployment with Ease

