

Cloud computing in web based virtual microscopy



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Cloud computing

1. Definitions
2. Use in web-based virtual microscopy
3. Practical experiment
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CLOUD COMPUTING

Web-Based Applications That Change
the Way You Work and Collaborate Online



Includes
coverage of
Google collaboration
tools, Apple's
MobileMe, and
much more!

What is cloud computing?

- Many definitions, ex:
 - “Cloud computing is Internet-based computing, whereby shared resources, software and information are provided to computers and other devices on-demand, like electricity”
 - “Computing in which services and storage are provided over the Internet (or ‘cloud’)”
 - “Cloud computing is a general term for anything that involves delivering hosted services over the Internet.”

Definitions

- Often divided into three categories:
 - Platform-as-a-Service
 - Software-as-a-Service
 - Infrastructure-as-a-Service

Infrastructure-as-a-Service

- Virtualized internet servers that can be 'hired' on-demand
- Recent (2009-) boost in performance
- Many competing vendors – costs down
- Easy-to-use administration interfaces
- Worldwide availability

AWS Management Console - Windows Internet Explorer

https://console.aws.amazon.com/ec2/home?region=eu-west-1

aws.amazon.com | AWS | Products | Developers | Community | Support | Account

Amazon S3 | **Amazon EC2** | Amazon Elastic MapReduce | Amazon CloudFront | Amazon RDS

Navigation

Region: EU West

- > EC2 Dashboard
- INSTANCES
- > Instance Profiles
- > Spot Requests
- IMAGES
- > AMIs
- > Bundle Tasks
- ELASTIC BLOCK STORE
- > Volumes
- > Snapshots
- NETWORKING & SECURITY
- > Elastic IPs
- > Security Groups
- > Key Pairs
- > Load Balancers

Amazon EC2 Console Dashboard


Getting Started

When you start using Amazon EC2 you will want to launch a virtual server, known as an Amazon EC2 instance.

Launch Instance

Note: Your instances will launch in the EU West (Ireland) region.

Service Health

Current Status	Details
 Amazon EC2 (EU - Ireland)	Service is operating normally View complete service health details

Use in Web based virtual microscopy

- Applications outside the campus area requiring:
 - High viewing speed
 - Minimal regional differences in speed, availability

Applications

- Large scale (1000+), limited time
 - Congress slide seminars
 - Quality assurance rounds
 - Board exams
 - Common edu material

Requirements

- Depending on viewing system (streaming, tiling, file formats etc):
 - 1) Server processing capacity
- Independent of viewing system:
 - 2) Bandwidth
 - 3) Fast connection between server and client (usually means short distance also geographically)

Previously

- 2006: disappointing tests with cache servers (expensive, no streaming, ineffective for the purpose)
- 2007: ECP 21 conference - virtual microscopy network

ECP 2007 Web Slide seminars

- Academic study
- Purpose: Enable fast viewing in Europe
- A network of mirror image servers
- Connection speed measurement tool



2007 - Automatic connection speedtest

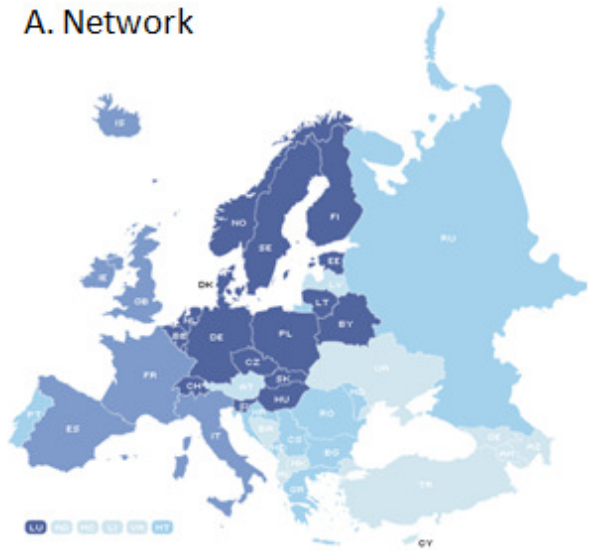
Network speedtest		
Server		Mbit/s
Helsinki	 	15,49
Stockholm	 	7,71
Poznan	 	5,69
Madrid	 	10,02
Niimegen	 	3,52

You are loading images from
the server in
Madrid, Spain

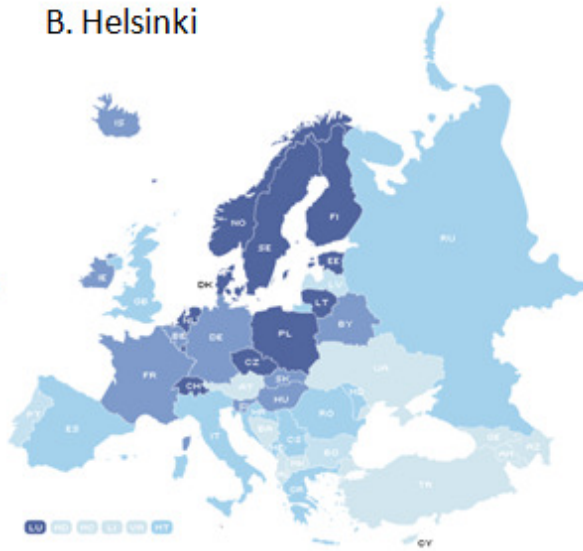
Recommended:
Helsinki

[Run test again](#) to select
automatically

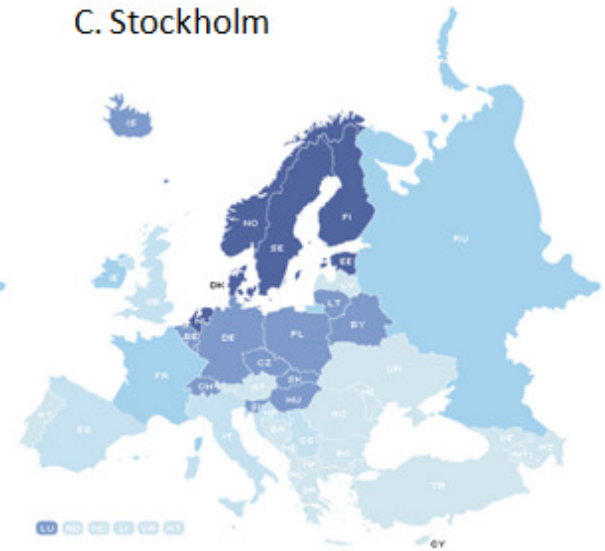
A. Network



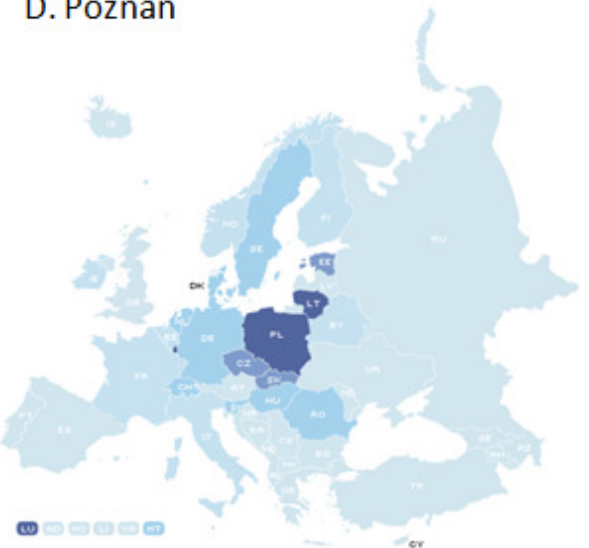
B. Helsinki



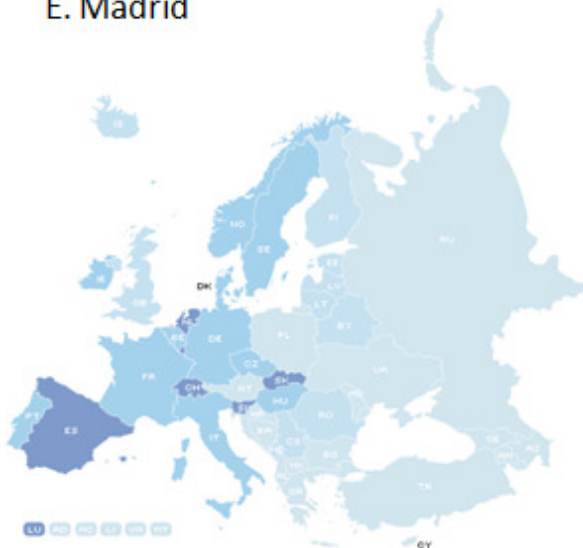
C. Stockholm



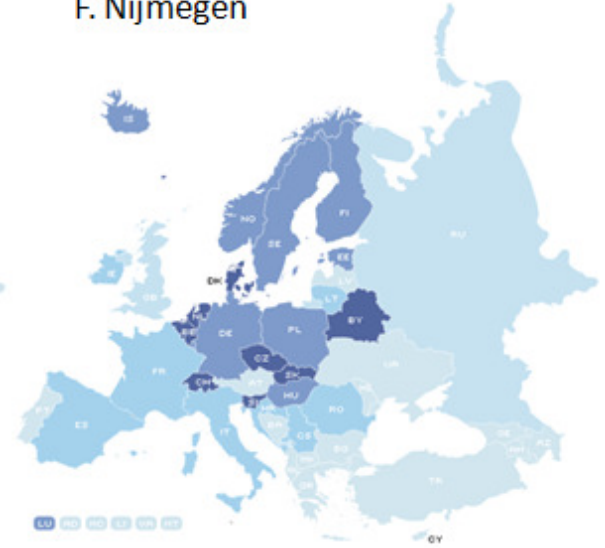
D. Poznan



E. Madrid



F. Nijmegen



Lundin M, Szymas J, Linder E, Beck H, de Wilde P, van Krieken H, García Rojo M, Moreno I, Ariza A, Tuzlali S, Dervişoğlu S, Helin H, Lehto VP, Lundin J. A European network for virtual microscopy-design, implementation and evaluation of performance. *Virchows Arch.* 2009 Apr;454(4):421-9.

M Lundin

2009

- Slide seminars of the ECP 2009 in Florence
- Network of department servers
- One Cloud server
 - 64 bit, 8 core Xeon 5400 class
 - "Western Europe" Area

The screenshot shows the WebMicroscope website interface. At the top left is the WebMicroscope logo, a globe icon. To its right are links for [Contact](#), [Login](#), and a search bar with a right-pointing arrow. Below the logo is a navigation menu with [Home](#), [Seminar sessions](#), and [Contact & support](#). The main banner features a blue background with a white outline of a city skyline. On the left, there are three small images: a building, a dome, and a statue. To the right of the images, the text reads "22nd European Congress of Pathology" in large white font, with "September 04-09, 2009" and "Florence Italy" in smaller white font below it. At the bottom of the banner, it says "Welcome to the Slide Seminars of the ECP 2009".

Practical experiment

- Aim: to evaluate whether a cloud server of today is up to the task

Methods

- 50 unique 800x600pix view fields (containing tissue) from each of the 100 largest virtual slides from the ECP22 seminar cases (tot 5000 view fields/run)
- Real-time server-side jpg tiling from wavelet compressed files (uncompressed size 45-240GB)
- Speed measurement run from 3 of the other servers (Poznan, Madrid, Stockholm), repeated 12 times

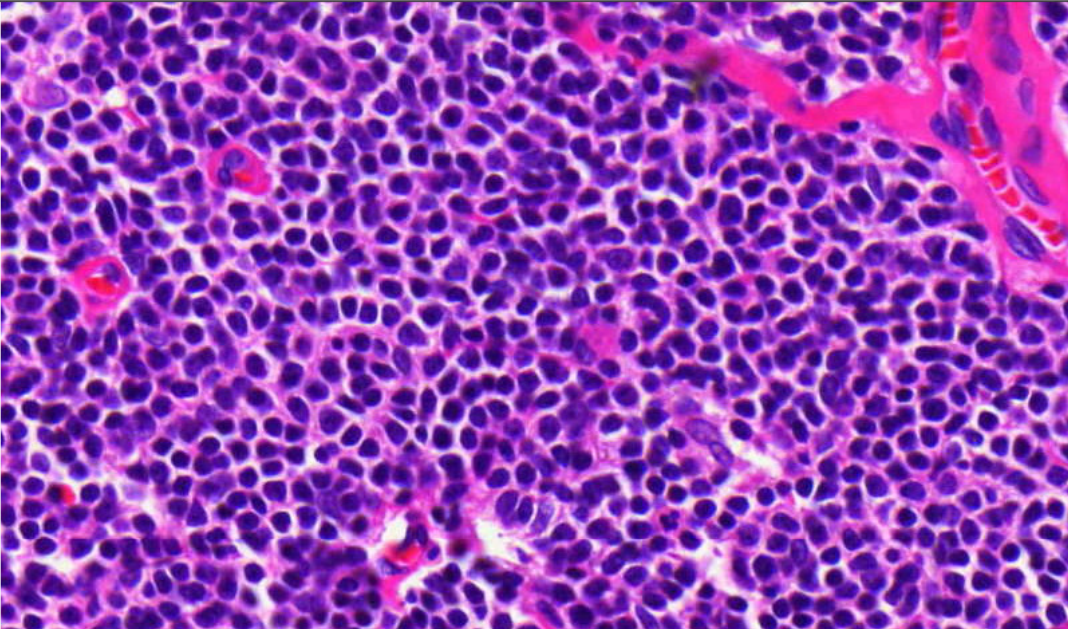
Benchmarker - Windows Internet Explorer

http://79.125.6.85/Benchmark2.aspx?sn=Cloud&ns=100&rv=50&xs=800&ys=600

Archivo Edición Ver Favoritos Herramientas Ayuda

Favoritos Sitios sugeridos Galería de Web Slice

Benchmarker



Next Coords

x-offset 1000

y-offset 1000

Start benchmarking

Benchmarking started	Wed Jan 6 10:55:57 UTC+0100 2010
Benchmarking completed	Wed Jan 6 11:49:49 UTC+0100 2010
Total time (seconds)	3231.6
Viewfields displayed	5000
Viewfields displayed/s	1.5
Data displayed (MB)	9155.3
Data displayed (MB/s)	2.8

Listo

Sitios de confianza 100%

Results

	<u>Cloud server</u>	<u>Helsinki server</u>
View fields/sec	1.1 – 1.6	1.3 – 1.8
Data / sec	2.1-2.8 MB	2.5-3.2 MB

Totally 180.000 viewfields / server

Almost on par with the Helsinki server

Summary - Advantages

- Server capacity and bandwidth on demand
- Targeted geographical areas
- Instant setup, any OS
- Convenient (no aging hardware, automatic backups, software included, etc)
- Inexpensive for short-time use

Summary - Considerations

- Processing power – just enough for real-time tiling (2009)
- Disk drive speed (tiled viewing systems)
- Legal issues – moving patient image data outside campus/hospital area
- Uploading – not as quick as to a campus server
- Pricing – still expensive in 365 d/year use

Considerations – costs /instance

US – N. Virginia	US – N. California	EU – Ireland	APAC – Singapore
Standard On-Demand Instances		Linux/UNIX Usage	Windows Usage
Small (Default)		\$0.095 per hour	\$0.12 per hour
Large		\$0.38 per hour	\$0.48 per hour
Extra Large		\$0.76 per hour	\$0.96 per hour

■ \$160 / week

US – N. Virginia	US – N. California	EU – Ireland	APAC – Singapore	
One-time Fee				
Standard Reserved Instances	1 yr Term	3 yr Term	Linux/UNIX Usage	Windows Usage
Small (Default)	\$227.50	\$350	\$0.04 per hour	\$0.06 per hour
Large	\$910	\$1400	\$0.16 per hour	\$0.24 per hour
Extra Large	\$1820	\$2800	\$0.32 per hour	\$0.48 per hour

■ \$ 80 / week

Considerations – transfer costs

Internet Data Transfer

The pricing below is based on data transferred "in" and "out" of Amazon EC2.

Data Transfer In	US & EU Regions	APAC Region
All Data Transfer	Free until Nov 1, 2010 *	Free until Nov 1, 2010 *

Data Transfer Out **	US & EU Regions	APAC Region
First 1 GB per Month	\$0.00 per GB	\$0.00 per GB
Up to 10 TB per Month	\$0.15 per GB	\$0.19 per GB
Next 40 TB per Month	\$0.11 per GB	\$0.15 per GB
Next 100 TB per Month	\$0.09 per GB	\$0.13 per GB
Over 150 TB per Month	\$0.08 per GB	\$0.12 per GB

* Data Transfer In will be \$0.10 per GB after November 1, 2010.

Considerations – total costs

- Typical congress (140 slides, 100 GB)
- Server instance costs
 - 4 weeks before and 2 weeks after congress
 - \$480 - \$960
- Data transfer costs
 - In: \$10 / server instance
 - Out: \$50 (1500 sessions, average 250MB/session)
- Total for server instances on 3 continents
 - \$1500-\$3000

Conclusions

Computer
Cloud

- Processing capacity and connection speed adequate for web based virtual microscopy
- Targeted on-demand capacity will make arrangement of large-scale events much easier
- Affordable for large scale projects

