D-FET – A Community Cloud for Enhancing Skills using Virtualised Environments and Cloud-based Infrastructures

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Community Cloud

- Overview for Cloud Computing.
- How Cloud Infrastructures could be used for teaching to enhanced skills.
- D-FET – A Community Cloud.
- Example used within teaching.
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> Overview of Cloud Computing
Introduction

Changing trends

Mainframe

Computers connect to services (SoA)

Servers

Computers connected to servers

Terminal

Stand-alone computers

1980's

Image of old-fashioned car and people wearing 1970's clothing.
Private Cloud – owned and run by an organisation

Community Cloud – shared by several organisation, with a common policy, compliance, mission, etc

Public Cloud – owned by an organisation selling a cloud infrastructure

Hybrid Cloud – two or more clouds
**On-demand self-service.** Consumers get server CPU, memory, bandwidth and storage resources whenever required.

**Location independent resource pooling.** Multiple customers use shared resources within the provider, without actually knowing where the exact location of these are.

**Rapid elasticity.** Consumers can easily scale-up and scale-down, whenever required.

**Pay per use.** All access to resources is monitored, and paid for either by advertising or usage. Payment methods: per users created, per hour usage (service), etc.
Q: Rate the challenges/issues ascribed to the 'cloud'/on-demand model
(1=not significant, 5=very significant)

- Security: 74.6%
- Performance: 63.1%
- Availability: 63.1%
- Hard to integrate with in-house IT: 61.1%
- Not enough ability to customize: 55.8%
- Worried on-demand will cost more: 50.4%
- Bringing back in-house may be difficult: 50.0%
- Regulatory requirements prohibit cloud: 40.2%
- Not enough major suppliers yet: 44.3%

Source: IDC Enterprise Panel, August 2008, n=244

Audit/compliance
Can I be compliant with statutory and regulatory requirements?
- Where is my data stored?
- Who handles breach notifications?
- How long is my data stored for?
- How is eDiscovery handled?
Amazon CloudFront
This allows content to be placed close to the places where it is to be consumed, the content thus gets moved to the edge of the cloud to support rapid delivery of content.

Amazon SimpleDB
This produces a mixture of structured data storage with the reliability of a traditional database.

Amazon Elastic Cloud Compute (Amazon EC2)
This is the core of the Amazon Cloud, and provides a Web services API to create, manage and delete virtual servers within the Amazon Cloud. This includes US, Asia (Japan and Singapore) and European data centres (Ireland), and uses the Xen hypervisor for the management of the servers.

Amazon Simple Storage Service (Amazon S3).
This provides data storage with web services through APIs. It differs from normal filesystems in that it does not have a hierarchical structure. Instead it uses buckets, which are unique namespaces across all of the Amazon customers. It is thus not a filesystem, and is a Web service, thus applications need to be written which specifically store data into the S3 Cloud.

Amazon Virtual Private Cloud (VPC)
This allows for complete network infrastructures to be built, which are isolated from other network infrastructures.
Amazon Machine Images (AMI)

$ ec2-describe-images -o AKIAIWUMTTAZYST2I2AA
$ ec2-describe-images
IMAGE ami-45c22e2c powerdns/image.manifest.xml 495219933132 available private
$ ec2-run-instances i-0d895566
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the Amazon customers. It is
thus not a filesystem, and is
a Web service, thus
applications need to be
written which specifically
store data into the S3 Cloud.

- Data storage: $0.125 per
  GB per month.
- Windows desktop: $0.12
  per hour.
- Designed to provide
  99.9999999999% durability
  and 99.99% availability of
  objects over a given year
  – less than one hour per
  year.

```
s3cmd mb s3://bill.bucket
s3cmd put myfile.mp3 s3://bill.bucket/myfile.mp3
s3cmd get s3://bill.bucket/myfile.mp3 myfile.mp3

s3cmd ls
s3cmd ls s3://bill.bucket/

s3cmd delete s3://bill.bucket/myfile.mp3
s3cmd rb s3://bill.bucket
```
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> How Cloud Computing could be used to enhance skills
Community Cloud – shared by several organisations, with a common policy, compliance, mission, etc.

Public Sector
- Evaluation of systems.
- Training.

Industry
- Training/sharing materials.
- Professional certification

Government
- Define standards
- Evaluate products

Academia
- Training/sharing materials
- Virtualised environments

Software Vendors:
- Test environments.
- Promoting products.
- Providing floating licences

Existing Academic Clouds

Public clouds
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D-FET: e-Forensics Community Cloud – shared by several organisations, with a common policy, compliance, mission, etc.

Scottish Police
- Triage systems
- Training

Government
- Define standards
- Evaluate products

Industry
- Training/sharing materials.
- Professional certification

Academia
- Training/sharing materials
- Virtualised environments

Digital Forensics Vendors
- Test environments.
- Promoting products.

Cloud@Napier
- links to existing Clouds
Distance learners
- Exact environments as face-to-face students.
- Blended learners have greater choice and flexibility.

Industry
- Adding evaluation infrastructures.
- Post project work/interesting areas of work.
- Ability to review materials presented to students.
- Ability to study within the workplace.

Enhancing skills
- Supports a wide range of pre-built environments within a sandboxed infrastructure.

Working across institutions
- Cloud environments allow for working across traditional boundaries.

Project work
- Students can start from existing well-tested environments.

Engaging students
- State-of-the-art infrastructures

Group working
- Students can integrate their systems in an isolated environment.

Robust infrastructures
- No more 9-5pm, Mon-Friday environments.

Continuation of work
- Students can carry their infrastructures throughout modules/years.

Snap-shots of work
- Student can create snap-shots, and move back and forward amongst them.

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> Example used in teaching
Difficult to use many of the techniques within a real-life space

Virtual spaces allow for a more complex and deeper understand of how to secure infrastructures

Demands on professional certification

Employers now require in-depth knowledge and a range of skills
Virtualised and Cloud-based labs (AWS):
- Range of state-of-the-art operating systems and tools.
- Evaluation of Public Cloud resources.

Teaching of four modules in computer security, digital forensics and database systems for 2010/2011 (inc. CSN09102/CSN10102/CSN11112) - BEng/BEng (Hons)/MSc

Virtualised and Cloud-based labs:
- Complex infrastructures for evaluation for students.
- Deep analysis of security and digital forensics in an isolated environment.
- Industry standard tools and methods.
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> Some results
17. Within a computing module, which is the main advantage of using VMWare images:

- They allowed experience of real-life virtualised infrastructures
- They allowed an in-depth analysis of the network activity
- They allowed an in-depth analysis of the host
- They allowed the usage of tools within a sandboxed environment
- They have allowed me to study remotely
- They can be easily installed at home
- They allowed experience of using operating system infrastructures
- Lab setups which were already pre-prepared
- They all the setup a wide range of operating systems
3. For VMWare images, they allowed you to setup a wide range of operating systems.

4. For VMWare images, they supported lab setups which were already pre-prepared.
Virtualised environments using stand-alone images (VMWare)

Web-based virtual environment with the interconnection of VM images

Traditional stand-alone computers with the OS and tools already prepared

Using AWS with a range of environments

13. In labs, which environment do you prefer:
10. For AWS, they allowed experience of using real-life cloud infrastructures.

11. For AWS, they have allowed me to study remotely.
8. For AWS, they allowed me to setup a wide range of operating systems.

9. For AWS, they supported lab setups which were already pre-prepared.
Skills:
- Allows students to remotely complete labs.
- Students training on state-of-the-art infrastructures.
- Different labs can be created for different situations (Linux/Oracle/Windows IIS/etc).
- Supports remote/distance learning.
- Infrastructure can be ring-fenced.
- Supports group work in an isolated environment.
- In-depth analysis of infrastructures.
- Students can build systems from scratch.
- Students can update their own infrastructure/tools, as required.
- Seems to engage the students, and show them a wide potential.
- Encourages students to continue work after the lab/tutorial.
- Time windows of labs/tutorials can be carefully controlled.
- Extensive and complex infrastructures assessed within a sandboxed environments.

Drawbacks:
- Requires an investment in time in creating and maintaining the virtual image.
- Students can avoid the lab situation.
- Possibly requires a backup strategy for labs (if using network-based virtualisation – but has advantages that a standalone version does not need a network connection).
- Goes against the stand-alone machine philosophy.

Other advantages:
- Easy for teaching team to update.
- Helps with franchised colleges.
- Easy setup for classroom demonstrations.
- Infrastructure can be ring-fenced.
- Produces repeatable labs.
- Not dependent on Napier/network infrastructure.
- Time windows of labs/tutorials can be carefully controlled.
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