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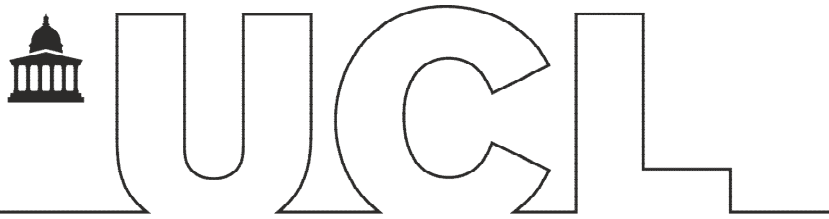

Lecture Capture Project

Design Authority Document

Author: Jason Norton,
Reference: Lecture Capture
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Contents

Document History

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Revision History

Date of this revision: 27 January 2009
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Revision Date	Previous revision date	Summary of Changes	Changes marked
14 December 2009		Initial draft	
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Approvals

This document requires the following approvals

Name	Signature	Title	Date of Issue	Version
Ross Martin		Design Authority	15/01/10	V.1

Distribution

This document has been distributed to:

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Ross Martin		
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1. Introduction

The projects deployment plan is to roll out Echo lecture capture appliances to 10 lecture theatres by the 1st September 2010. These 10 systems would then be used to pilot the Lecturecast service during the 2010-2011 academic year.

During the period September 2010 to September 2011 further systems would be slowly deployed in response to identified needs, faculty requests and lecture theatre refurbishments. A total of up to 20 systems are planned and these will be deployed in lecture theatres identified by the Audio Visual department (Deployment Plan below).

NB. It is intended to allow faculties to request additional theatres outside of the initial 20 theatre deployment if they supply their own Echo appliances and licences (e.g. Eastman Dental would like to deploy 3-5 systems and there has been interest from the Medical School and Engineering).

Stage	Description	Resources required	Deadline
2	Plan Echo Server Deployment with Systems	IS Management	Jan 31st 2010
2	Ensure Server Deployment is entered into 90 day planning schedule	IS Management	Feb 28th 2010
2	Purchase/Order servers	IS Management Project Manager	March 31st 2010
2	Purchase Echo360 capture appliance	Project Manager AV	June 31st 2010
2	Install Pilot Servers	2 x IS Systems 1 x LaMS IS-Networks	June 31st 2010
2	Deploy Echo360 capture appliance	2 x AV 1 x LaMS IS-Networks	August 31st 2010
3	Plan Redundant Server Deployment with Systems	IS Management	November 30th 2010
3	Ensure Server Deployment is entered into 90 day planning schedule	IS Management	TBA
3	Purchase/Order servers	IS Management Project Manager	TBA
3	Purchase remaining Echo360 capture appliances	Project Manager AV	Jan 2011-Aug 2011
3	Install Service Redundant Servers	2 x IS Systems 1 x LaMS IS-Networks	TBA
3	Deploy remaining Echo360 capture appliance	2 x AV 1 x LaMS IS-Networks	August 31st 2011

2. System Adoption and Expansion

The adoption rate for lecture capture at UCL is a difficult question to answer. The statistics offered by Echo360 suggest UCL should expect a 30% growth year on year as a maximum expansion for both the actual number of captures and views of presentations. Echo360 also recommend a maximum of 4 lecture captures per day, with the average capture time of 75 minutes long. This takes into account two hour lecture series that are not broken into 1 hour items.

This data is based on work that Echo360 undertook with Mike Fardon, who introduced a digital lecture capture system (the precursor to Lectopia) at University of Western Australia (UWA) 10 years ago. Echo360 combined data from all Australian institutions it was working with and with information from UWA to determine what were reasonable adoption rates.

The information provided by Echo360 from the Australian study.

1 The adoption of lecture capture is mature at a majority of institutions in Australia.

2 Lectoptia included a feature that reported back viewing statistics from their customers, providing a wealth of data to reference.

3 Mike Fardon has been tracking the use of lecture capture data in Australia for 10 years and has a substantial set of data.

There are three factors that Echo360 believe have significant impact on growth at institutions.

1 The adoption of an opt out policy. At many institutions all courses were captured unless an instructor specifically asked for the class not to be captured.

2 The introduction of podcasting as a recognised teaching and learning tool.

3 Institutions that expended significant effort driving adoption, such as directly engaging their academic community and actively promoting the service to the target users.

From the last academic year in 2009 Echo360 also calculated the number of captures per classroom per day at UWA at 2.1 captures per day. The number of captures for the larger “premier teaching spaces” was almost 4 captures per day.

Another reference quoted by Echo360 is from Dan Roberts at the London School of Economics (LSE). They have experienced a growth in the number of captures of 10% per year. LSE have decided not to expand significant effort driving adoption because they find that growth rate comfortable.

2.1 Server requirements for Echo Service Deployment

It should be noted that the following deployment scenarios are based on a best practice model suggested by the manufacturer and that they are intended to cope with a maximum usage model of 8 hours a day 5 days a week.

Recommend Server Specification (excluding storage) for Echo servers is:-

- Dual Quad Core Intel Xeon 2.0Ghz
- 4GB RAM
- 200GB
- Windows 2008 Server

2.1.1 Deployment for 10 appliances suggested installed for September 1st 2010

- 1 Streaming Server – Currently deployed
- 1 System Server (Echo(ESS) service)
- 1 SFTP Server
- 1 Web Server
- 1 mySQL server – Current mySQL server can be used
- 1 Media Processor server

2.1.2 Deployment for 20 appliances suggested installed for September 1st 2011

- 2 Streaming Servers (load balanced) – Currently in deployment
- 1 Echo System Server (ESS)
- 3 Web Server
- 1 mySQL server (dedicated if not implemented on initial deployment)
- 2 Media Processor servers

2.1.3 Difference in Phase 1 and Phase 2 Deployment (2010-2011)

- 2 Web Server
- 1 mySQL server
- 1 Media Processor

Adding redundant infrastructure to support a 20 machine deployment would require the addition of:

- 1 Streaming Servers (load balanced)
- 1 Echo System Server (ESS) (Additional server redundancy only)
- 1 FTP Server (Additional server redundancy only)
- 1 Web Server (load balanced)
- 1 mySQL server (Additional server redundancy only and not required)

2.2 Virtualisation

Echo360 support virtualisation for all servers in their environment, however they suggest processor servers may be impacted due to the high disk IO and CPU usage that are required for the encoding.

2.3 Content Storage

2.3.1 Current Storage

At the current time all lecture capture content is being stored on the flash media servers local hard disks. The current usage for the 2009 term has been 80Gb for 115 recorded items. This currently leaves a capacity of 1Tb of usable storage. Once a retention policy on the archive format has been reached this should be reduced to approximately 45Gb.

Using these figures and the planned lecture captures from the existing technical trial users, by the end of the academic year 2009-2010 UCL should have 120Gb of content, or approximately 75Gb once the archive is removed.

2.3.2 Storage Use

Each Echo360 1 hour capture requires a maximum of 1GB of storage. If you take the maximum capture potential for the intended 20 capture systems (8 hours a day, 5 days a week, 11 weeks a term, 2 terms per academic year) we could be producing **17.6TB** each academic year.

However a retention policy of 1 month for the editable archive format and 2 years for edited lecture content will give the following maximum 2 year cyclic storage requirements for 20 systems.

6 months	= 4.9TB
12 months	= 9.2TB
18 months	= 14.1TB
24 months	= 18.1TB

2.3.3 Storage Requirement

The requirement for additional storage beyond the current 1Tb local disks will depend on one key factor:

- Daily hourly use of appliances

This hourly use will in turn be controlled by the uptake of academic users. The planned deployment of the Echo360 means that all captures have to be pre-scheduled so the exact hours of recording are always known, and thus the expected storage requirement can be identified. At the end of this document you can see a graph showing the number of hours against Mb of captured content. Using this information UCL would exceed 1Tb by producing 1000 hours of material with no retention policy, or 1900 hours of material, using the suggested policy of deleting original archive after 1 month.

If we work from the expected Echo360 maximum of a fully operational deployment of 10 appliances (4 hours per appliance) we would require the SAN environment to be available :-

- 4 hours per 5 days = 20 hours per week
- 10 appliances x 20 hours = 200 hours per week

- 5 weeks with no retention policy
- 9 weeks with the retention policy

During the technical trial the Faculty of Chemistry and Biochemistry courses on average captured 50 hours of lectures. With our current storage solution we would be able to accommodate up to 38 similar course series before we required to migrate to the SAN solution. Knowing the usage rate the project team will be able to control the uptake and maintain control over the pilot stage of the project. This would ideally lead to a robust solution being available for the academic year 2011-2012.

Using the figures included and a sensible controlled approach to the use of the system and what can be supported with the available staff, we should be able to extend the use of the current attached storage possibly into the end of the 2010-2011 academic year. This also takes into account that there will be little additional material being produced during the remainder of the 2009-2010 academic year.

2.3.4 Storage Architecture

In order to deliver content online correctly and within a scalable architecture Echo360 recommend the storage subsystem should take the form of a SAN,

At UCL the SAN requirement will be delivered as part of the 24/7 stack being deployed by Information Systems. This deployment is due for a completion date during quarter 2 next year. The project manager of the Lecture Capture Project will work closely with the director of IS and the selected project manger to ensure that the requirements for the Lecture Capture Project are met.

2.4 Backup

Current requirements for the backup of content are being met by the Central Storage team who have confirmed that there is current capacity to backup all the existing content storage prior to the SAN deployment.

The backup requirement for the SAN deployment will be fulfilled as part of the 24/7 stack being deployed by Information Systems. The Lecture Capture Project Manager and Online Media Board will be meeting in early 2010 to discuss and decide retention policies for content.

3. UCL Network Requirement / Impact

3.1 Recording Upload

Each Echo360 device uploads a file package via SFTP to the ESS servers designated storage system. This upload occurs once the device has completed recording.

Each Echo360 appliance has a 10/100 Ethernet connection

The size of the file package changes due to content however an estimated maximum file size for 1 hours captured material is 500MB. The ESS FTP server throttles the upload to 1Mbps. This may change when UCL ship the ESS FTP server to its own dedicated server, at which point greater control can be applied. However, given the 1Mbps UCL currently has the following calculations can be made:

Using this upper estimations of 500MB of file per 1 hour capture that needs to be uploaded from the appliance.

1. Converted from bites to Bytes (1 B = 8 b)
   1/8 = .125
   (1 Mb/second)/(1 B/8 b) = .125 MB/second

2. Convert to MB/minute (1 Minute = 60 Seconds)
   0.125 x 60 = 7.5
   (0.125 MB/second) x (60 seconds/minute) = 7.5 MB/minute

3. Calculate the number of minutes it will take a 1 hour capture that is 500 MB to upload.
   500/7.5 = 66.67
4. 500 MB/(7.5 MB/minute) = 66.67 minutes

Therefore each hour of capture should finish uploading in 1 hour and 7 minutes. While the upload of captures will fall behind if the captures happen back to back, even with eight 1 hour captures taking place back to back the last upload would finish 56 minutes after the last capture ends. (7 minutes long x 8 captures). Although estimating on the high side with the figures this is still fast enough to upload 8 hours of capture in a 24 hour period and for them to be transcoded.

We can also draw from this that if all boxes simultaneously uploaded content it would create a network peak of 20Mbps. This occurrence would have little network impact as this load is distributed around the UCL network at different physical locations and the FTP server would not be under strain on its standard 1Gb connection.
The Network Group has confirmed that this peak upload would not create any impact on the network, and that it would take an exceptional number of appliances to generate noticeable traffic that could affect the UCL network, especially when the devices are not located in one central location but are distributed throughout UCL.

3.2 File transfer between Echo System Servers

File transport occurs between the Echo system servers. This is required for processing the files and moving them to their correct shares. The recommended structure would be an attached

storage system such as SAN to minimise network traffic and provide all required servers with direct access to the content. It is expected that the SAN mentioned here will be the 24/7 SAN infrastructure planned by Information Systems.

3.3 Required viewing bandwidth (Stream and web-SWF)

The standard concurrency rate used by Echo360 for its larger lecture capture deployments is 3% of the student population, based on a 10% concurrency rate.

Each rich media Echo presentation requires approximately 600 kbps of bandwidth. This requirement is a conservative estimate, and Echo360 believes that average usage will be lower.

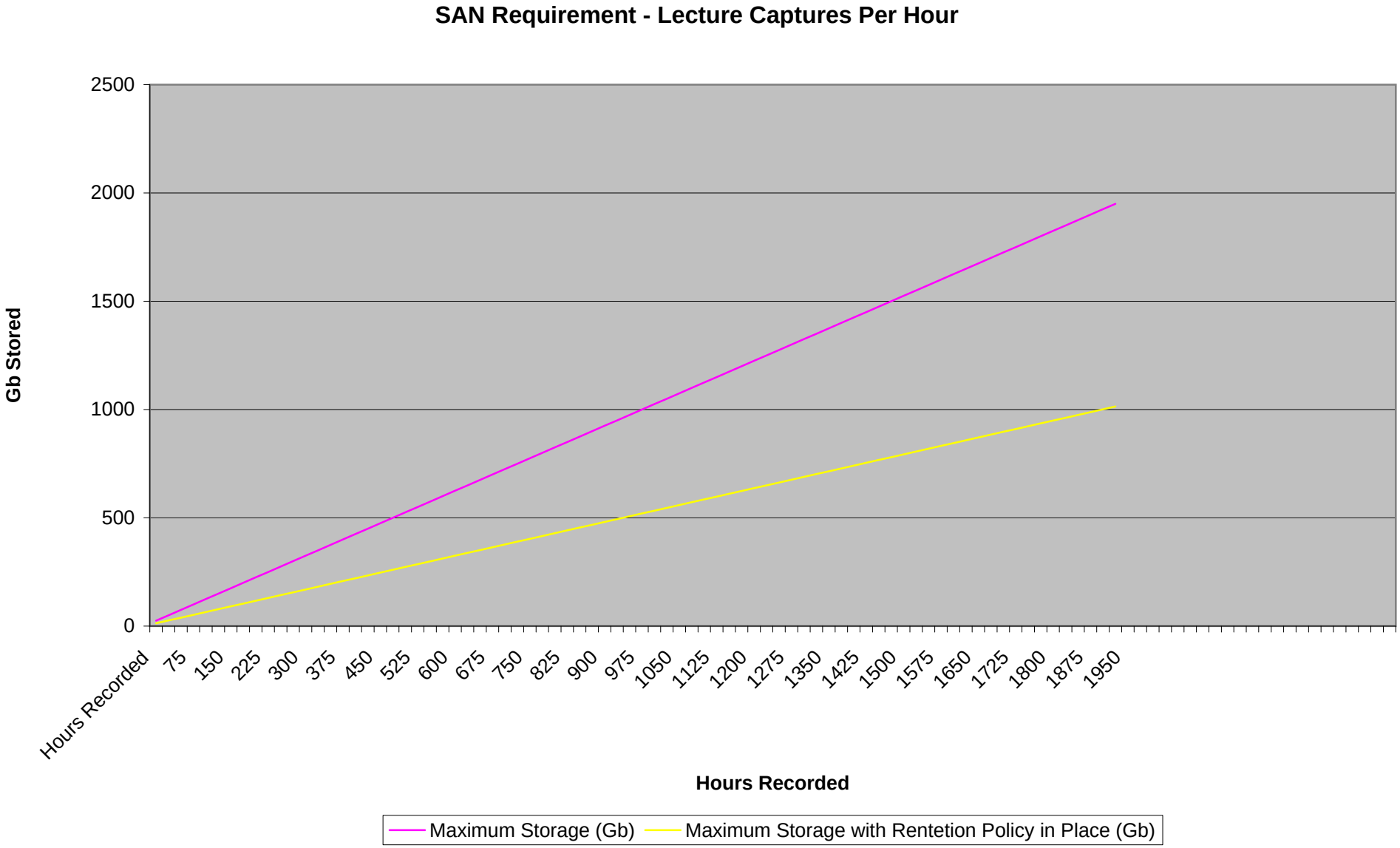
- The streaming server will require: **212 Kbps per connection**
- The Web server will require: **388 Kbps per connection**

1800 concurrent connections (10% UCL student population) would require a total bandwidth utilisation of **1GB of bandwidth (1800x600 kbps=1.05 Gbps)**.

This breaks down between both web and streaming server to give load of:

- Web Server **682 Mbps**
- Streaming server **373 Mbps**

Both web and streaming servers are on 1 Gbps ports and it is intended to hardware load balance both web and streaming servers by September 2010.


SAN Requirement - Lecture Captures Per Hour
Gb Stored
2500
2000
1500
1000
500
0
Hours Recorded
75
150
225
300
375
450
525
600
675
750
825
900
975
1050
1125
1200
1275
1350
1425
1500
1575
1650
1725
1800
1875
1950
Hours Recorded
Maximum Storage (Gb)
Maximum Storage with Rentetion Policy in Place (Gb)