# Best Practice: Streaming Server for educational videos at Universities

#### T. Kutzner, C. Steinert

Brandenburg University of Technology Cottbus - Senftenberg, Senftenberg, GERMANY

Abstract— In this paper we present a video streaming solution. It describes the functionality of streaming server at our university and the workflow to embed videos into the learning platform Moodle. By the server-side role management teachers can get access to upload their recorded lectures to the server. Videos will be converted into different streaming formats and embed into the learning platform with provided embed code. The number of teachers who use this proposal is continuously growing at our university. Beside the lecture scripts the videos watched often by the students what the numbers of video accesses in the Moodle course and the streaming server traffic significantly show.

# *Index Terms*—Educational Video, Streaming, Servers, Distant *Learning*, Educational technology

# I. INTRODUCTION

Video media is an extremely powerful teaching resource, especially for engineering education. It has been observed that, use of video resources is increasing in departments of all disciplines [1]. In recent years, online video technology has increasingly found their way into the teaching at universities. Streaming video can enrich the courses necessary for this are stable, strong and at the same time easy to use performance streaming media services. We present a practically proven possible solution.

Since March 2012 a project supported by BMBF (Federal Ministry of Education and Research) for improving of the quality of education and blended learning was started and some new improvements in the topic eLearning are done at our university. Behind improvements in the learning platform and online tests at the last period, especially in the subject of lecture recording and learning videos was investigated. As an important base it was recognized early to install an own efficient video server. After research an exempt from charges solution was found and implemented. In addition to the free video server solution, there is also a commercial solution, here we speak only about the non-commercial community solution.

## II. TECHNICAL BASIS SYSTEM

Four hardware servers were purchased to run virtual machines. Two different server types Dell PowerEdge R620 and R720 for video streaming and eLearning were purchased to store all data 16 TB storage for eLearning, video server and data protection. The servers are connected with a hardware bridge, in case of a server is going down all virtual machines move to the second server without time delay or even failure. The server software as well as the virtualizations are based on Linux Server operating system. The administration of the virtual servers occurs about Virtual Machine Monitor (VMM) with the open source virtualization platform XEN [2]. The administrator is able to control, start and stop the virtual servers. The streaming service based on the HTTP protocol. Adaptive streaming based on HTTP enables the client to dynamically adapt the quality of requested video according to the available bandwidth, thus providing a better user experience and quality of service [3].

#### III. UPLOAD AND PUBLISHING VIDEOS

The streaming server bases on the free system Kaltura Community Edition Video Platform (Kaltura CE) [4][6]. Beside the administration (See Fig. 1) and the monitoring, three main functionalities are available to the user with publisher rights.



Fig. 1. Administration and Management Console

Il Jornadas Iberoamaricanas de Innovación Educativa en el ámbito de las TIC Las Palmas de Gran Canaria, 12-13 de noviembre de 2015

First one is the uploading function for recorded video files to the server. The publisher has the functionality to upload videos from the desktop directly to the server (See Fig. 2). During the Upload the videos are converted equally automatically into the desired formats. According to size of the video, the number of videos converting at the same time, number of the formats to be converted and server capacity, the process last some minutes up to hours. The users who watch videos notice nothing of the process because the conversion is independent of the streaming process.

🌼 Kaltura	Dashboard	Content	Studio	Analytics	Settings	Administration	Upload 💙
Tobias Kutzner, Welcome to the	e Kaltura Management Conso	le. You are logged in	as a Publisher A	dministrator user in the	e Tobias Kutzner acco	unt.	
Upload Content							
	Easily import content alread Upload media files from you Quickstart Guide Tip: Upload, import an	by hosted on the we ur computer Download ( d create entries from	b (bulk upload) CSV/XML San n any page with B	<b>nples</b> ne Upload Menu in th	e top navigation. Lear	Submit Upload fr n More	CSV/XML bm Desktop
Embed Content on Y	our Site						
$\bigcirc$	Select a video and embed i Create and embed a playlis Quickstart Guide	a player on your site t (or multiple playlist:	s) on your site			Embe	d Player d Playlist
Customize Features	and Design						
	Customize feature set and Quickstart Guide	design of a pre-defi	ned player or crea	ate a new player from	scratch	Custom	ize Players

Fig. 2. KMC Dashboard

Second the transcoding settings is the functionality to convert videos in different formats for automatically streaming (See Fig. 3) and the third function to generate embed code for Moodle [5][7]. (See Fig. 4) In addition, different video players can still be created and integrated to the server. Publishers can design their own player with own design with color, size, special buttons and a list with branch marks to the different subjects in the videos. Therefore it is easier for the user to reach the desired part in the video.

🐝 K	alt	ura Dashboard	Content	Studio	Analytics	Settings	Administration	Upload 💙
Acc	ount S	ettings Integration Settings	Access Control	Transcoding Settings	Custom Data	My User Settings	Account Upgrade	
Defa	Default Transcoding Elavore							
Kaltura	s playe	er provides optimal playback by using ad	laptive bitrate techno	logy and automatically selec	ting the most approp	riate file for playback bi	ased on the viewer's spec	cific connection an
Each vi	deo or	audio file uploaded to the system will be	transcoded to the d	efault flavors selected below	N.			
	ID	Conversion Flavor	Description		Format		Codec	
•	0	Source	Maintains the o	riginal format and settings o				
	1	HD	High Definition		flv		vp6	
	2	High - Large	High web quali	ty, large frame	flv		vp6	
	3	Standard - Large	Standard web	quality, large frame	flv		vp6	
	4	Standard - Small	Standard web	quality, small frame	flv		vр6	
•	5	Basic - Small	Basic web qua	ility, small frame. To be used	flv		vр6	
	6	HQ MP4 for Export	High web quali	ty in MP4 format, to be used	mp4		h264	
	7	Editable	Good web qua	ity, to be used for editable of	flv		vp6	
	8	Basic - Small (H264)			mp4		h264	
	9	Standard - Small (H264)			mp4		h264	
¥	10	Standard - Large (H264)			mp4		h264	
•	11	High - Large (H264)			mp4		h264	
•	12	HD (H264)			mp4		h264	
	13	Pad	Pad		mp4		h264	
	14	Mobile (3GP)	Nokia/Blackber	ry	3gp		mpeg4	
	15	Mobile (H264) - Basic	iPhone,android		mp4		h264b	
	16	Mobile (H264) - Standard	Mobile (H264) -	Standard	mp4		h264b	

Fig. 3. Transcoding settings for different video formats

ilters		+ Entries	Table			
earch Entries	Q	Thumbnail	ID	Name	also: 100 - 100 - 2 Sate ion Boti	Ту
Additional Filters			0_mo1o98vw	Bsp2_sho	A destand O antibud (2)	8
Categories	Edit		0_z8pcdbvn	Wildlife		H
All (10)			0_ptaffsps	DE MONS		H
<ul> <li>fish (2)</li> <li>bd content (1)</li> </ul>			0_145246lu	Widlife		E
☐ image (1)			0_n22yvyqb	LOGO ET		
video (2)			0_v1g3rq86	Sample B	11 41-44 51-07 4 ) HD OT • 414 10 750	E
			0_edn0fghh	Sample K	Select Player: KDP3 Dark skin   Katura player includes both layout and functionality (advertising, sublities, etc)	
			0_kigx06bi	Sample K	Select Flash Delivery Type: Progressive Download (HTTP)	
		0_dyp0wvco	Excelent	Adaptive Streaming automatically adjusts to the viewer's bandwidth, while Hogressive Dewnload an buffering of the centent, Read more		
			0_n8ruho8z	Normal w	Support IPhone & IPad with HTML5 Hype enable the HTML5 player, the viewer device will be automatically detected. Read more Uncertaintee the HTML5	E

Fig. 4. Video contend and embed code Kaltura

Since current year teachers of our university upload videos to the server and embed into Moodle. There are two ways to embed videos into Moodle. The first one uses text field in Moodle and embed code from the server (See Fig. 5, 6), second worked with a direct link to the player at server (See Fig. 7). Students can watch the videos in the Moodle course with PC and mobile devices. The player embed code at the moment is only for Flash Player, the next upgrade to a newer version will bring HTML5 Player functionality, then all mobile device can get easy access to the videos.

<b>b-tu</b> Brandenburgische Technische Universität Cottbus - Senftenberg		
Startseite - Kurse - Verschieden	es • Testkurse • Kutzner, Tobias • Kaltura • Tennet ra	a "Thoma 1" hinzulugot
Navigation	Textfeld zu "Thema 1" hinzufügen ( Grundeinträge	ð
<ul> <li>Dashboard</li> </ul>	Textfeld	B Aboatz + B / E E & C / E E D
Website Geser Kurs Kaltura Feilnehmer/innen Allgemeines Thema 1 Thema 2		Tentis de child (public degli domini)" intra redda "Hild (Inderth y also conserver throeleg Hode) resource-"Hild (public degli domini also redda galan (ungel domini also domini also domini d) y 1 galanti" also anna mare "also di la conserver he avait di antide (phonedgetta atte, phi 1445/7000) reame" also domini also domini also domini also domini also domini also domini also domini reame" also domini also domini also domini also domini also domini also domini also domini reame" also domini also domini also domini also domini also domini also domini also domini reame" also domini also domini also domini also domini also domini also domini reame" also domini also domini also domini also domini also domini also domini reame also domini also domini also domini also domini also domini also domini reame also domini also domini also domini also domini also domini also domini reame also domini also domini also domini also domini also domini reame also domini also domini also domini reame also domini also domini also domini reame also domini also domini reame also domini also domini reame al
Thema 3		Format p
<ul> <li>▶ Thema 4</li> <li>▶ Thema 5</li> <li>▶ Thema 6</li> </ul>	Weitere Einstellungen     Voraussetzungen	
<ul><li>▶ Thema 7</li><li>▶ Thema 8</li></ul>		Speichern und zum Kurs Abbrechen

Fig. 5. Embed code Moodle

Students can easily open and close the videos in the Moodle course. The player automatic detects the bandwidth according to Internet connection for the transmission and could be enlarged infinitely variable depending on the screen size.



Fig. 6. Watch embed video in Moodle



Fig. 7. Watch video direct link in Moodle

## IV. EXAMPLE COURSE AND ACCESS STATISTICS

As an example we cited a course of civil engineering with 35 students from the actual semester. For every lecture unit and practice in this course on the learning platform we can find videos retrieve from video server (See Fig. 8).

Übung	en
2 1 2	Übung_1 Video 22:10:2015 Übung 1 27:10:2015 Verformungsfiguren statisch bestimmter Systeme Übung_1 Video 27:10:2015
Vorles	ingen
1	2 Vorlesung Statik 20.10.2015
0	2a Video Vorlesung 20.10.2015
	2b Video Vorlesung 20.10.2015
	3 Voriesung Statik 22.10.2015
	3a Video Vorlesung 22.10.2015
<b>S</b>	3b Video Vorlesung 22.10.2015



In this course learning videos are almost as often called as lecture scripts. In Figure 9 at the left side are the different activities in the course and on the right side the access to the activities.

Aktivität	Zugriffe
d Nachrichtenforum	23
💼 Übungsaufgaben	85
Übungen	
Übung_1 Video 22.10.2015	17
Übung 1 27.10.2015 Verformungsfiguren statisch bestimmter Systeme	5
🔊 Übung_1 Video 27.10.2015	2
Vorlesungen	
2 Vorlesung Statik 20.10.2015	39
a Video Vorlesung 20.10.2015	22
2b Video Vorlesung 20.10.2015	12
3 Vorlesung Statik 22.10.2015	15
a Video Vorlesung 22.10.2015	10

Fig. 9 Access lecture scripts and videos beginning of semester

For monitoring the administrator has access to the streaming server up- and download statistic. In Figure 10 we can see the inbound and outbound traffic in bits per second for a period of ten days from the beginning of the actual semester. Green color is when the teacher (content manager) or administrator upload new videos to the streaming server and blue color are the streaming access when students watch the videos. After uploading a new video there's a big increase in access to the streaming server what the blue graphs clearly show.



Fig. 10 Video streaming server traffic

# V. CONCLUSION

In this paper a video streaming server solution was introduced. The practical application at our university was shown by the role management on the server lecturers that can upload videos and embed in their courses. The connection between video server and learning platform is produced with embed code and direct linking. At the moment we test the direct binding of the server to Moodle with the help of the Kaltura Moodle module; with this we enable the lecturers to load videos directly from Moodle to the server. By the Community the development of this server software continuously goes on. So next time an upgrade of the actual video server for a newer Kaltura version around even more functionalities and a better performance will be carried out. We ascertain that learning videos are as important as lecture scripts. Whether learning videos are more popular or better than scripts for learning, we cannot say yet, this could be found out in an extensive study.

#### REFERENCES

- [1] V. B. Dharmadhikari, "Creating Educational Lecture Videos Compatible with Streaming Server using Low Cost Resources", International Conference on Technology for Education, 2011, pp. 116-120
- [2] Xen Project<sup>TM</sup>, [Online]. Available: http://www.xenproject.org
- [3] Krsto Lazic, Ilija Basicevic, and Jelena Kovacevic "Bandwidth Estimation in Adapti v e Video Streaming Over HTTP", International Conference on Consumer Electronics (ICCE), 2015, pp. 62-65
- [4] Video Streaming Server BTU Cottbus Senftenberg [Online]. Available: http://videoserver.hs-lausitz.de
- [5] Moodle Lernplattform BTU Cottbus Senftenberg, [Online]. Available: http://elearning.hs-lausitz.de and https://www.tucottbus.de/elearning/btu
- [6] Kaltura Open Souce Video Platform, [Online]. Available: http://corp.kaltura.com/
- [7] Moodle, [Online]. Available: https://moodle.org

Il Jornadas Iberoamaricanas de Innovación Educativa en el ámbito de las TIC Las Palmas de Gran Canaria, 12-13 de noviembre de 2015

# ACKNOWLEDGEMENT

This work was supported by BMBF (Federal Ministry of Education and Research) for improving of the quality of education and blended learning.

We would like to thank Prof. Dr.-Ing. H. Hübel, Fakultät für Bauen BTU Cottbus - Senftenberg for the course and educational video resources and Mr. H. Lehmann from HRZ Senftenberg for technical server support.



**TOBIAS KUTZNER** received the B.Sc. degree in 2009 in Computer Science at University of Applied Science HS Lausitz, Germany, and his M.Sc. degree in 2012 at the same University. Parts of his Master Thesis he wrote at University of Las Palmas de Gran Canaria (ULPGC). His research

fields are client server solutions, mobile programming, web services, artificial intelligence and eLearning. Since 2012 he is working as administrator and developer for the eLearning platform at University of Applied Science HS Lausitz and since 2013 for eLearning platform and video server at BTU Cottbus – Senftenberg too. In 2014 he started Ph.D. at ULPGC in research topic handwriting verification systems.



**CHRISTIAN STEINERT** is engaged in the Project "Blended Learning Anfangshürden erkennen zur Unterstützung der fachspezifischen Studienvorbereitung und des Lernerfolges im ersten Studienjahr" since September 2014. His activities include creating and designing E-Assessments in mathematics. Since the

beginning of his employment within the project, he already lectured at several conferences on different deployment scenarios of modern learning scenarios, which have a high E-Learning-Proportion.