LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

HYDRALAB IV – Remote Access to Experimental Facilities

603/17/17063/2010

RADE – 8th Experience on Remote Access - 16th December 2013

January 2014

Report HYDRALAB IV n. 2/2014

INDEX

FIGURE INDEX

Acknowledgements

The authors would like to express their gratitude to the FCT (Fundação para a CCiência e a Tecnologia), through its branch FCCN – http://www.fccn.pt, the Portuguese Foundation for the Scientific Computing, for its technical support to this project. The support of Claudio Silva from FCCN is also acknowledged.

The participation of Jens Kirkegaard and Dennis Ahansen from DHI, Stuart McLElland from the University of Hull, Rüdiger U. Franz von Bock und Polach from Aalto University, Diogo Neves from LNEC (Portugal) and João Santos from Lisbon Superior Engineering Institute (Portugal) in the experience realized at 16th December 2013 of this project, through his collaboration in testing the remote access as end-users of the system, is acknowledged.

LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

RADE – 8th Experience on Remote Access – 16th December 2013

1 INTRODUCTION

The present report describes a laboratory experience on remote access to physical experiment tests for a 2D model, tested at the COI1 wave flume on the 16th of December 2013. This is one more experience taken at the maritime hydraulic facilities of the Harbour and Maritime Structures Division, of the Hydraulic and Environmental Department of the National Laboratory of Civil Engineering. Previous tests were performed on the:

- 27th of January (Capitao *et al*. 2012a), 27th April (Capitão *et al*. 2012b), 6th June (Capitao *et al*. 2012b), 26th September (Lemos *et al*. 2012a), 15th October (Lemos *et al*. 2012a;
- 6th of March (Lemos et al. 2013a) and 3rd of June of 2013 (Lemos et al. 2013b).

There were also two experiences on data sharing: 22nd November (Lemos *et al*. 2012b), 5th December of 2012 (Lemos *et al*. 2012b).

This work is made on the framework of the project RADE, a Joint Research Activity of HYDRALAB IV – More than Water. RADE (Remote Access to Data and Experiments) will develop a robust set of information systems to improve access to experiments and data through the innovative use of modern data management, curation and communication technologies.

The main objective of this laboratory experiences was to test the procedures previously presented in Capitão *et al.*, 2012a,b, Lemos *et al.*, 2012a,b, 2013a,b, aiming to remotely access a laboratory experience on a tank where a 3D model resides.

After the objectives (Section 2), Section 3 of the present report describes the experiences made at COI1 flume. In Section 4, final comments and future work are presented.

2 OBJECTIVES

The objective of the experience made at 16th December 2013, described in the present report, was to further test and report the efficiency of the procedures previously presented in Capitão *et al.*, 2012, in Fortes *et al.*, 2012 and in Lemos *et al.*, 2012, 2013a,b. This experience took place at the COI1 wave flume, located at LNEC´s premises.

During the test, several researchers from different institutions located in Europe (Jens Kirkegaard and Dennis Ahansen from DHI, Stuart McLelland from the University of Hull, Rüdiger U. Franz von Bock und Polach from Aalto University, Diogo Neves from LNEC, Portugal, and João Santos from Lisbon Superior Engineering Institute, Portugal, were invited to remotely access the experiment and to produce comments on the observed performance and usability of that experience.

As described in previous reports, the methodology is based on the use of a fairly simple scheme composed of a video camera apparatus, installed at the flume, which is connected to a PC computer where the software "Microsoft Expression Encoder" resides and where video and images are decoded and sent to a web server for storage and sharing with selected guests. This server will then enable real-time streaming over the internet, enabling a direct, quasi-real-time, access to the video from web users.

3 DESCRIPTION OF THE REMOTE ACCESS EXPERIENCES

3.1 Maritime hydraulic experimental facilities of the Harbour and Maritime Structures Division

The usual testing hall for hydraulic tests with an area of 6,500 square meters was used. This hall is mostly occupied with testing flumes and basins for hydraulic model studies. Basins are used for three-dimensional studies of structure stability and wave penetration. Flumes are used for stability and overtopping tests of maritime structures. In the next section we briefly describe the COI1 flume, used in the present remote access experience. Those tests were performed at the COI1 wave flume.

COI1 flume is a wave flume used for studying propagating waves over a variable bed and their interaction with a maritime structure. It is possible to construct all kind of foreshore

bathymetries in this flume, both fixed bed and mobile bed foreshores, to ensure the wave behaviour in the model will be accurately reproduced according to the prototype. The flume is capable of generating both regular (periodic) and irregular (random) waves. The wave generator is equipped with a real-time active wave reflection absorption system. This means that the wave field reflected by the model structure that propagates towards the wave board is measured and the incident wave field that produced by the wave board is compensated for those unwanted reflected waves. In this way, undesired waves do not re-reflect towards the model and do not disturb the measurements. Table 1 shows the technical characteristics of COI1 flume. An overview of this flume is shown in Figure 1.

wave flume COI1
Length : 49.4 m
Width : 1.6 m
Height : 0.7 m
wave generator
Piston-type (translation) wave board
Full stroke : 22''
Maximum velocity : 1.6 m/s
wave characteristics
Frequency range between f = 0.01 Hz - 5 Hz
Maximum regular wave height *Hmax* = 0.4 m
Maximum significant wave height *Hm0* = 0.25 m
features
Glass wall flume with three meter long observation window
Remote-controlled instrument carriage

Table 1- Technical data of LNEC's COI1 wave flume.

Figure 1 - Overview of COI1.

3.2 Physical equipment used in the remote access experience

Figure 2 illustrates the equipment used during the test.

- Camera with the following characteristics:
  - A Canon 600D digital camera with the following video capabilities: PAL 720p, 25 fps
  - Lens: Canon EF-S 18-55mm 1:3.5-5.6 IS
- A laptop PC computer with the following characteristics:
  - Dell Latitude E6500 - Intel Core 2 Duo Processor T9600 (2.8GHz, 1066MHz FSB, 3GB RAM)
- Video acquisition hardware
  - Conceptronics CHVIDEOCR A/D Convertor DAQ board with provided cables
- Flexible tripod "Joby Gorillapod SLR Zoom"

Figure 2 - Laptop computer (Windows XP, 4 GB RAM) used to receive conveyed video signal from A/D Convertor DAQ board. Also shown are the Canon camera and zoom lens, the Gorillapod, cables (with USB-composite video adapter) and the "USB Conceptronics A/D Convertor DAQ board".

3.3 Software Equipment

The software used in the video decoding and streaming was, again, the Microsoft's Expression Encoder 4 (free version). Encoding was established with the following video and audio characteristics:

- Video 25 fps, 1000 Kb/s
- Audio 128 Kb/s (2-channel 16-bit 48 kHz)

Microsoft's Expression Encoder 4 is a commercial software program able to encode a wide array of video file formats, stream live from webcams and camcorders or screen capture from PC's. It also enables making simple edits to video files and enhancing available media with overlays and advertising. A free (although limited in its capabilities) version of this software was used in all experiences (Figure 3).

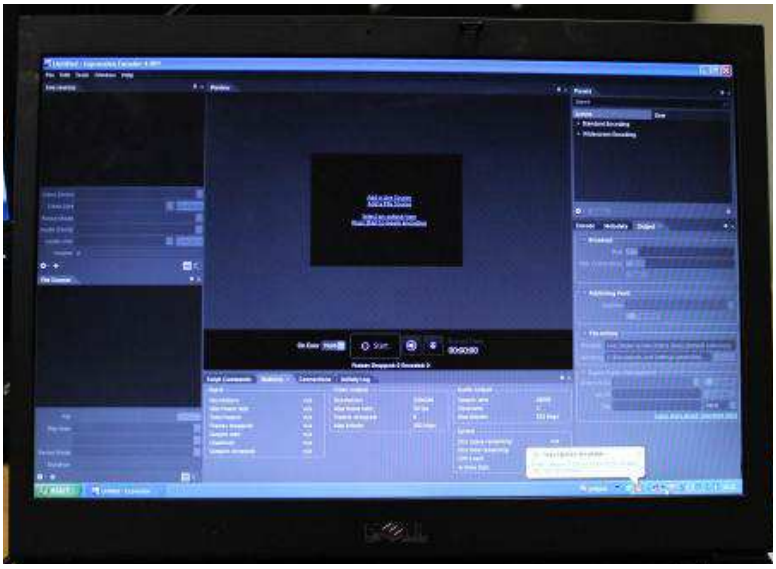


Figure 3 - Software equipment.

3.4 Description of the remote access experience

During the experience, the following steps were taken:

- Installation of a laptop PC Computer near the flume;
- Installation of the equipment (Figure 4 and Figure 5):
    1. Setup of the camera. Turn the camera on. On the top right dial, change operation mode to "Movie". Frame the subject and press shoot button

halfway to autofocus the subject. Then change the AF/M lens button from autofocus to manual focus.

Figure 4 – Setup of camera in the final position and video mode operation selection.

2. Connect camera to the computer. The connection between computer USB port and camera is made through use of a Conceptronics A/D Convertor DAQ board.

Figure 5 - Cable connections between camera and computer.

- Use of the free version of Microsoft's® Expression Encoder 4 software (http://www.microsoft.com/expression/products/EncoderPro_Overview.aspx);

- At desktop, click the shortcut for Microsoft's® Expression Encoder 4. The encoder program will start (Figure 6);
- Open file "Encode_LNEC_canal" to start job "LNEC_canal". (Figure 7);
- A small window showing the active job (the video scene), will appear at the screen left upper corner (Figure 8).

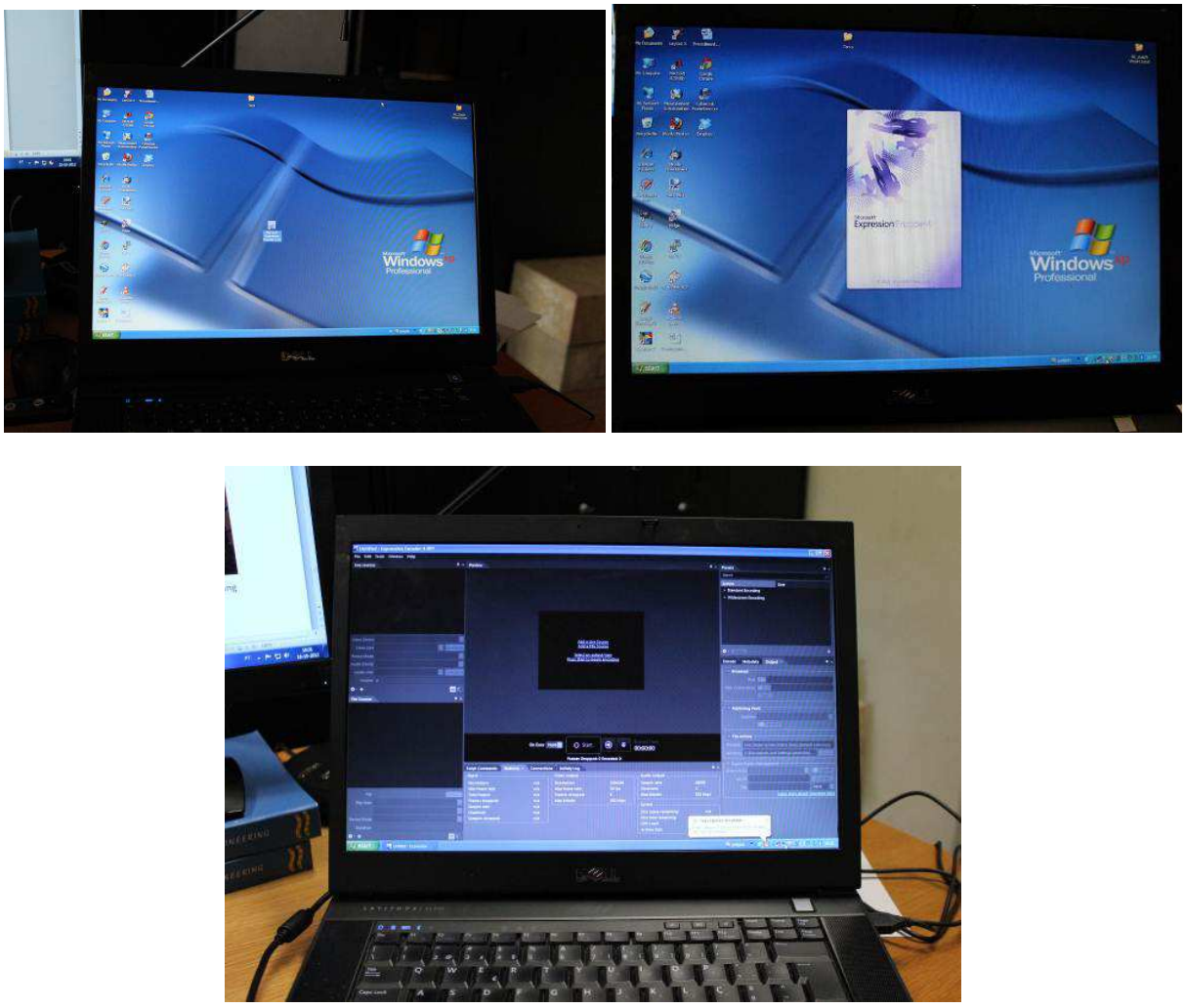


Figure 6 - Starting Microsoft's® Expression Encoder 4 software.

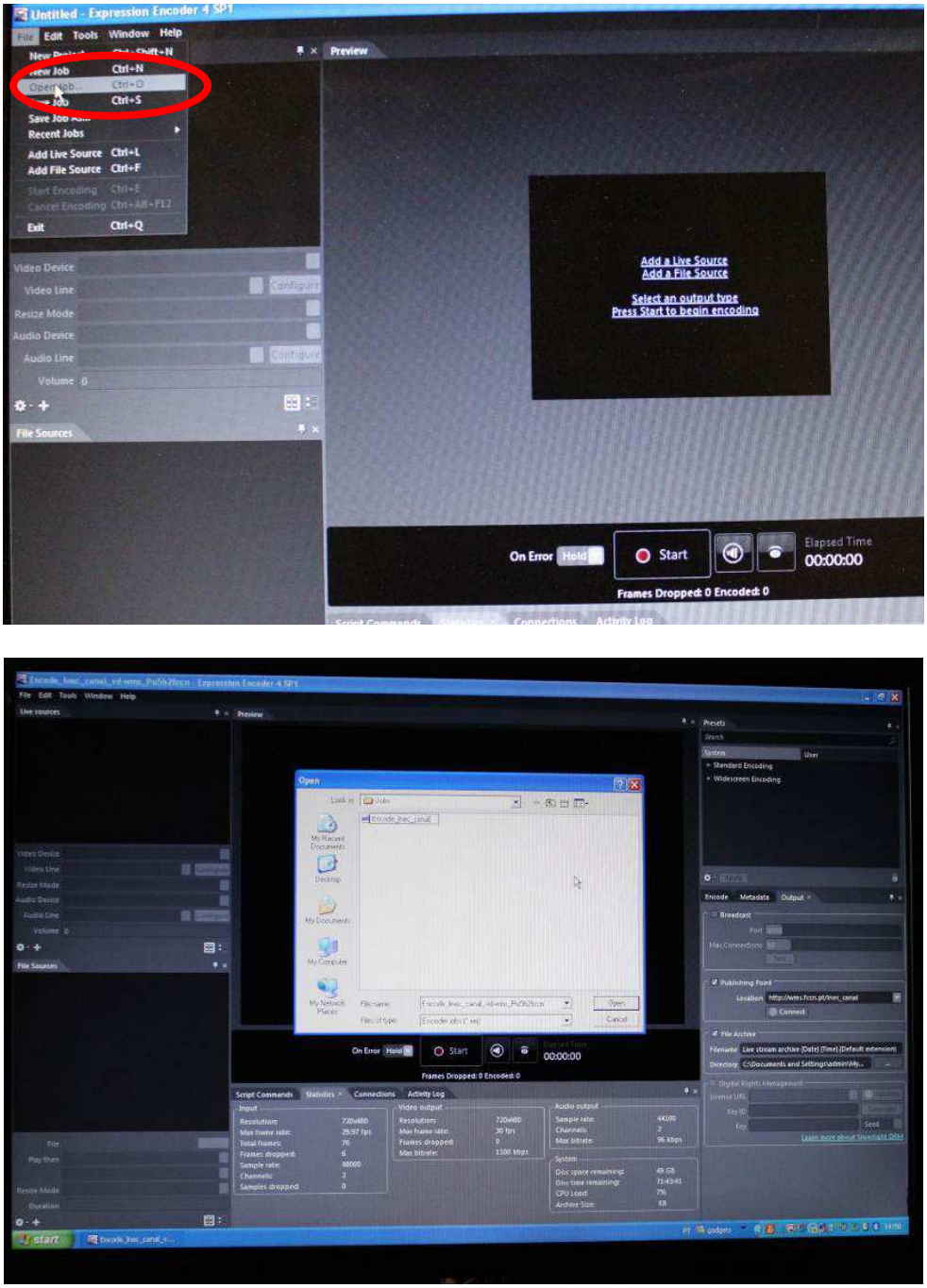


Figure 7 - Using Microsoft's® Expression Encoder 4 software: Open file "Encode_LNEC_canal".

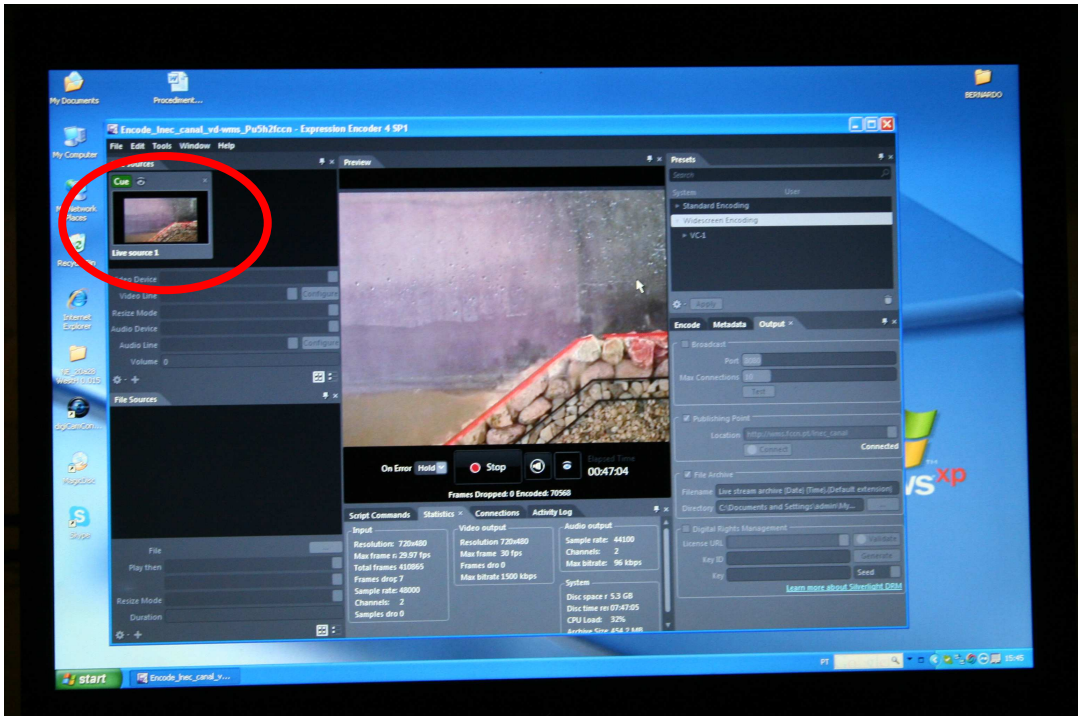


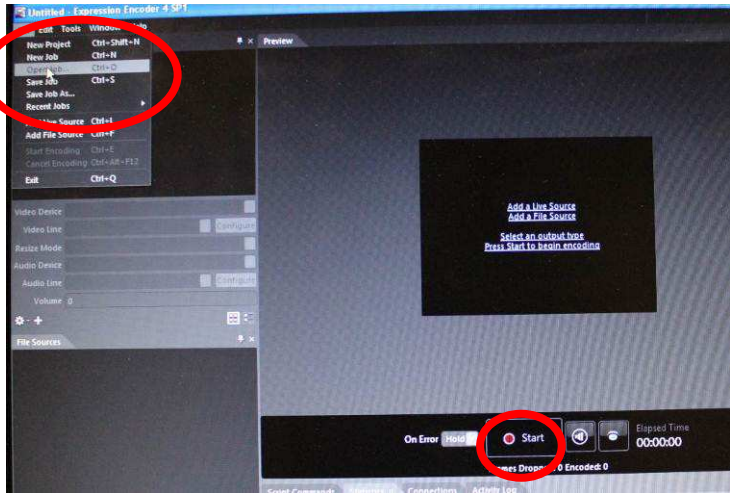
Figure 8 – Using Microsoft's® Expression Encoder 4 software: View of the active job "Encode_LNEC_canal".

- Activation of the wave generator at the wave flume to generate waves (Figure 9)

Figure 9 - COI1 flume. General view of test operation.

- Click start button at Microsoft's Expression Encoder 4 (Figure 10a). After a while, an authentication window appears where server's username and password should be provided (Figure 10b).
- This will begin the video streaming at the *http://wms.fccn.pt/lnec_canal* server (publishing point), Figure 11.

a)



b)

Figure 10 - Using Microsoft's® Expression Encoder 4 software: a) Click start button b) Authentication window.

Figure 11 - Video streaming on Microsoft's Expression Encoder 4 software.

Broadband internet access is recommended to guarantee high quality transmission. In the present experiences LNEC's "Ulisses" wi-fi network was used. During the video stream a video file is stored at the publishing point (for streaming), as well as in the computer disk (Figure 12).

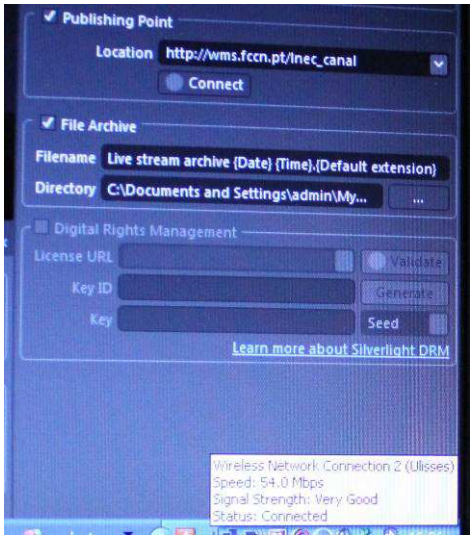


Figure 12 – Internet access using local 54 Mbps wi-fi network.

Access to the web address: **http://wms.fccn.pt/lnec_canal** (Figure 13). During the experience, a computer, outside LNEC's network was used by using MS Windows Media Player (WMP) through Internet Explorer (IE), in a Macintosh system. However, both Linux or PC systems may also be used.

Figure 13 - Windows Media Player playing video.

3.5 Results

In the experience made at 16th December 2013, five different computers at different European countries location were used. The main internet and computer characteristics of each of them are presented at Table 2.

Table 2 – Internet and computer characteristics

INSTITUTION	LOCATION	USER	COMPUTER CHARACTERISTICS	INTERNET CHARACTERISTICS
ISEL	Lisbon Portugal	João Alfredo Santos	Intel Atom CPU N270 @ 1,60 GHz RAM: 0.98 GB	IPv6 Net Coaxial cable 1 Gbps download 1 Gbps upload
LNEC	Lisbon Portugal	Diogo Neves	Intel(R) Core(TM)2 Quad CPU @2.40 GHz RAM: 3.00GB Windows 7 ; 64-bit	Type: LAN Speed: 100 Mbps
University of Hull	Hull United Kingdom	Stuart McLelland	Type: Windows 7 PC CPU: Core2 Quad 2.5GHz RAM: 4GB	Type: LAN Speed: ~50Mbps
DHI	Hørsholm, Denmark	Jens Kirkegaard / Dennis Ahansen	Type: Lenovo ThinkPad T 530 CPU: Intel I7, 2.3 GHz RAM: 8 GB	Type: LAN Speed: 1 Gbps (Shared)
Aalto University	NTNU, Norway	Rüdiger U. Franz von Bock und Polach	Type: Laptop CPU: Intel Core 2.5 GHz RAM: 4GB installed (2.9 usable)	Type: WIFI Speed: ca 50Mbps

Table 3 presents the main comments made during the experience by each of the users.

Table 3 – Main conclusions of the experience made at 16th December 2013.

INSTITUTION	IMAGE FREEZING	IMAGE DELAY	IMAGE QUALITY
ISEL	no	27 s	Very Good
LNEC	no	26 s	Very Good
University of Hull	Twice	-	Very Good
DHI	no	15 s	Excellent
Aalto University	no	26 s	Very Good

Video files were produced during this experience. From these results one may evaluate the performance of the video transmission or identify other problems.

The main conclusions arising from the experience made at 16th December 2013 were:

- An adequate image quality of the video images was attained at all times;
- Image freezing occurred twice at University of Hull. This could be a typical network problem that is likely to occur. Actually, although LNEC's internal network speed should theoretically guarantee 100 Mbps, on some conditions (high traffic levels and users) a much lower throughput is sometimes observed. If this happens, a solution that may solve the problem is to update existing network cables (coaxial) to optical fibre;
- DHI showed an excellent delay image (15 s), because it was the lowest one ever achieved during all the experiences made by LNEC;
- Observed delay ranged from 15 to 30 s, depending mainly on the internet speed.

4 CONCLUSIONS

This report describes the eighth experience on remote access made at LNEC's COI1 wave flume on the 16th of December 2013.

The methodology used is based on the use of a video camera installed at the flume or tank, which is connected to a PC computer. Video and images are decoded and sent to a server, via HTTP, which will then enable real-time streaming over the internet, allowing a direct, quasi-real-time access to the video from web users.

The main conclusions arisen from this set of tests were the following:

- Methodology is very simple and easily portable;
- End-users that collaborated in this test confirmed a very good image quality reception and almost no dropped frames. A small number of freezing images was detected on only one institution. A delay from 15 to 30 seconds was observed;
- LNEC´s web page for RADE project can be accessed at

  http://www.lnec.pt/organization/dha/npe/estudos_id/RADE/index_html/?searchterm=RADE

REFERENCES

[1] Capitão, R.; Silva, C.; Fortes, J.; Lemos, R. (2012a). "HYDRALAB IV – Remote Access to Experimental Facilities. RADE - First Results" - NPE, LNEC, fevereiro.

[2] Capitão, R.; Fortes, J.; Lemos, R. (201b). "HYDRALAB IV – Remote Access to Experimental Facilities. RADE - Second and Third Experiences on Remote Access" - NPE, LNEC, junho.

[3] Lemos, R.; Fortes, J.; Capitão, R. (2012a). "HYDRALAB IV – Remote Access to Experimental Facilities. RADE – Fourth and Fifth Experiences on Remote Access" - NPE, LNEC, outubro.

[4] Lemos, R.; Fortes, J.; Capitão, R. (2012b). "HYDRALAB IV – Remote Access to Experimental Facilities. RADE – First Experiences on Data Sharing Using Remote Access" - NPE, LNEC, dezembro.

[5] Lemos, R; Fortes, J; Capitão, R. (2013a). "HYDRALAB IV – Remote Access to Experimental Facilities. RADE – 6th Experience on Remote Access" - NPE, LNEC, march

[6] Lemos, R; Fortes, J; Capitão, R. (2013b). "HYDRALAB IV – Remote Access to Experimental Facilities. RADE – 7th Experience on Remote Access" - NPE, LNEC, june

LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

Lisbon, January 2014

Authors:

Rute Lemos

Higher Research Technician, LNEC

Conceição Juana Fortes

Senior Research Officer, LNEC

Rui Capitão

Research Officer, LNEC

APPENDIX I

Comments on the experience made at 16th December 2013, from the collaborators

LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

-------- Original Message --------
Subject: RE: Experience at LNEC - today: 15:00-16:00
Date: Mon, 16 Dec 2013 16:24:57 +0000
From: Stuart J McLelland <S.J.McLelland@hull.ac.uk>
To: jfortes@lnec.pt <jfortes@lnec.pt>

Hi Juana,

Interesting to watch! My results are below.

Stuart

INSTITUTION	**University of Hull**
LOCATION	UK
USER	Stuart McLElland
COMPUTER CHARACTERISTICS	Type: Windows 7 PC CPU: Core2 Quad 2.5GHz RAM: 4GB
INTERNET CHARACTERISTICS	Type: LAN Speed: ~50Mbps
OCCURRENCE OF IMAGE FREEZING	Image lost twice – reappeared shortly later
TRANSMISSION TIME DELAY	
IMAGE QUALITY	Very good

-------- Original Message --------
Subject:RE: Experience at LNEC - today: 15:00-16:00
Date: Mon, 16 Dec 2013 15:22:00 +0000
From: Jens Kirkegaard <jkj@dhigroup.com>
To:jfortes@lnec.pt <jfortes@lnec.pt>

Dear Juana,
Here are the details.
Best regards
Jens

INSTITUTION	**DHI**
LOCATION	JK office
USER	Jens Kirkegaard / Dennis Ahansen
COMPUTER CHARACTERISTICS	Type: Lenovo ThinkPad T 530 CPU: Intel I7, 2.3 GHz RAM: 8 GB
INTERNET CHARACTERISTICS	Type: LAN Speed: 1 Gbps (Shared)
OCCURRENCE OF IMAGE FREEZING	None
TRANSMISSION TIME DELAY	Juana – please add
IMAGE QUALITY	Excellent

-------- Original Message --------
Subject: RE: Experience at LNEC - today: 15:00-16:00
Date: Mon, 16 Dec 2013 16:30:32 +0000
From: von Bock und Polach Rüdiger <ruediger.vonbock@aalto.fi>
To: jfortes@lnec.pt <jfortes@lnec.pt>, claudio.neves@pq.cnpq.br <claudio.neves@pq.cnpq.br>

hej,
from my point of view it was working very well.
Saludos
R.F.

INSTITUTION	**Aalto University**
LOCATION	NTNU, Norway
USER	Rüdiger U. Franz von Bock und Polach
COMPUTER CHARACTERISTICS	Type: Laptop CPU: Intel Core 2.5 GHz RAM: 4GB installed (2.9 usable)
INTERNET CHARACTERISTICS	Type: WIFI Speed: ca 50Mbps
OCCURRENCE OF IMAGE FREEZING	Did not occur
TRANSMISSION TIME DELAY	Not noticed
IMAGE QUALITY	Very good