

# The Need of Stability and Reliability: An Analysis for Online Tests of Picture-Phone Solutions for Remote Scales

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**Abstract**— *As a result of rapid development for online technologies, there are many software options available for online picture-phone solutions. A potential usage for such solutions is supporting online learning and teaching activities in a remote scale, especially in face-to-face teaching. Though the choices have never been so many as now, there are still relatively few ordinary users to introduce or apply such solutions into their online courses, especially on a remote scale. For college or university users, it is important to test, introduce and apply such solutions into their daily learning and teaching activities. Such implementing is not only a part of integrating with online tests or laboratories, but also a part of sharing collaborative learning environments with other users. As a part of practice in picture-phone applications, there have been conducted online tests for different picture-phone solutions, in remote scales. The intention of tests was establishing a stable, reliable infrastructure for flexible learning environment with receipt partners. The main assignments were testing, analyzing and recommending software solutions and applications for these activities, so that lectures, student guidance, research seminars, and other academic meetings can be held in a meaningful way. The focus of tests was identifying a potential universal design and low-cost, suitable solution for ordinary users and equipments for remote picture-phone solutions. This research paper has analyzed and summarized major tests' outcomes and findings, and made recommendations for further use. The conclusions and summary of tests also highlight the need of stability and reliability for choice of such solutions, and possible challenges during the test process.*

**Index Terms** — *online picture-phone solutions, face-to-face teaching, tests' outcomes, remote scales.*

## INTRODUCTION

Project Embla is a joint research project between Østfold University College of Norway in Sarpsborg (HiØ-IR) and Istituto di Radioastronomia of Italy in Bologna (IRA). The scientists and researchers from both sides have been visited each other annually and the cooperation has also a spin-off effect for other areas, inclusive student project, stationed at IRA in Bologna. The current station arrangements have however been limited due to lack of a stable and established infrastructure for flexible learning environment, so the only students are in their final without course duties are able to take such a project.

There is therefore a need to establish such an infrastructure and learning environment for the further student projects, since the students have to take some courses from Østfold University College in Norway, while they work with the projects at IRA during their stay. As a part of this plan, a remote scale of test for online picture-phone solutions, and their practical applications was performed between IRA, Bologna, Italy and HiØ-IR, Sarpsborg, Norway.

The intention of this test was establishing a stable, reliable infrastructure for flexible learning environment with receipt partners. The main test assignments were testing, analyzing and recommending software solutions and applications for these activities, so that lectures, student guidance, research seminars, and other academic meetings can be held in a meaningful way. The focus of the test was identifying a potential universal design and low-cost, suitable solution for ordinary users and equipments for remote picture-phone solutions.

There are quite few online picture-phone solutions, so the choices are many. The main challenges of the test will be however identifying the applicable aspects of these solutions with low costs. Is it possible to deliver the online lectures through these solutions? Is it stable and reliable to use these solutions? How are we able to integrate the different elements to one meaningful online learning environment? What low-cost technologies and solutions should be used?

The current research paper has analyzed and summarized major test's outcomes and findings, and made recommendations for further use or implementing.

## KEY CRITERIA OF THE TEST AND TEST SCHEDULE

It was essential to focus on the key criteria of these online solutions, thus their applicable aspects. The following outlines need therefore to be evaluated during the test:

- Solutions and applications for live and archived lectures
- Convenience for online navigating and meetings
- Combining with web based courseware
- Possibility for online seminars and meetings
- Flexible learning infrastructure (integration of above elements)

## FEW AVAILABLE SOLUTIONS FOR ONLINE PICTURE PHONE

Based on both institutions existing equipments and own experiences, there are 3 following technically related online picture phone solutions available. They roughly differences in functions and costs are illustrated in table I

- IP online picture phone with a number of commercial software programs (IP phone).
- Online video streaming live or archive (Streaming))
- ISDN picture phone (ISDN).

TABLE I

A COMPARATIVE DESCRIPTION OF THESE 3 POSSIBLE ONLINE CONNECTION SOLUTIONS IS ILLUSTRATED AS THE FOLLOWING TABLE

Online Solution	Receiver	Communication	Software required	Applications	Reliability	Economy
IP phone	One or many	Duplex	Both sides	Meetings	Unknown	Low-cost
Streaming	Many	Simplex	Only sender	Lectures	Unknown	Low-cost
ISDN phone	One or many *	Duplex	Both sides	Meeting/lectures	Good	Expensive

\* It is theoretically possible to set up multi-receivers for ISDN. However, this will bring the drastic increasing for the equivalent expense and high risk for technical troubles.

ISDN picture phone was not a relevant option for the current test due to the high cost and incompatibility issues. The major tasks of the test were concentrated on testing and comparing different IP phone software programs and streaming solutions. The test schedule and plan are displayed in table II.

TABLE II

A TEST SCHEDULE FOR IP ONLINE PICTURE PHONE AND ONLINE VIDEO STREAMING LIVE OR ARCHIVE

Date	Technology	Primary Use	Category
April 30, 2002	Video streaming (live)	Distance lectures	Streaming
April 30, 2002	MS NetMeeting	Guidance and seminars	Conference
May 1, 2002	Video streaming (archive)	Distance lectures	Streaming
May 2, 2002	Video streaming (archive)	Distance lectures	Streaming
May 2, 2002	FlyConference	Guidance and seminars	Conference
May 2, 2002	VigorVCON	Guidance and seminars	Conference
May 3, 2002	MS NetMeeting	Guidance and seminars	Conference
May 3, 2002	VigorVCON	Guidance and seminars	Conference
May 3, 2002	Courseware*	Virtual classroom	Courseware

Courseware note: This test includes Lotus Learningspace, Authenticated User Community and MOO/Encore

## SOME TEST RESULTS

As mentioned in table II, the test of these online solutions are grouped into 3 different categories, so it is reasonable to group their results also into these 3 categories: 1) Streaming video (for distance lectures with test results and a summary); 2) Videoconference (for student guidance and seminars with test results and a summary); 3) Web based courseware (for virtual classroom applications with test results and a summary).

## Streaming video

The solution of online streaming delivers lectures both in video on demand and in live streaming of video over the Internet. It has proven good possibilities for serving live events over the web and delivering long-form media [1]. It can also be used for audio-only in the same way.

For this solution, there are several different technologies available. The current test used QuickTime/Darwin Streaming Server [2] due to the following reasons: 1) It is open source based software; 2) It is already well integrated with available hardware.

Our streaming server was set up for the specialized Real Time Streaming Protocol (RTSP). This protocol has several advantages for streaming live audio and video. It may however cause some problems with firewalls sometimes. At IRA we had to shut down the local client firewall in order to get the online streaming function working properly. There was however no need to book special Internet traffic privileges to do this at IRA, Bologna. As a result, this was an easy task to conduct.

For watching or listening to the streaming audio and video of a lecture, there are either specialized applications available such as QuickTime Player or an ordinary application as a standard web browser with the appropriate plug-in. A specialized client application may give the user more options, while a web browser may be more familiar and easy to use.

## Lectures

Once the technology is tested, the remaining part will be the applicable aspects. It was a clear intention to use streaming video for delivery of lectures from Norway, both in live and on demand forms. There is an ISDN videoconference room available already at HiØ-IR, Norway, and some of the standard equipments can be used for this streaming purpose. The same aspect of the tasks is transferring of lectures and class interactions in a remote scale. The different approach is using IP instead of ISDN, but also a far longer distance, which operates from Norway to Italy instead of domestic uses in Norway.

## Testing

In the testing we especially focused on the quality of video and audio we can send from main server at HiØ-IR to IRA. Live streaming was not able to test since there was a problem with local firewall, which was not solved in time. However, the bandwidth requirements and test results should be the same as for video on demand, so the qualities should also be the same.

## Summary

It is a vital part of this online infrastructure for flexible learning and research networks to receiving and following the distance lectures, both in live streaming and video on demand. The qualities of video and sound are therefore essential for the practical uses of the solution. The bandwidth available proved to be enough for the intended streaming. The testing reflects both streaming during daytime and evening. The quality available proved sufficient for the scheduled video broadcast. As detailed speed options indicated in the above table, bandwidth requirements as high as 100 KB/s experienced little problems when streaming long-form media. This bandwidth will allow 320x240 pixels at 12 frames/second.

TABLE III  
TEST RESULTS FOR QUICKTIME STREAMING

Streaming	Speed	Video Quality	Sound Quality	Notes
Live streaming	50K	NA	NA	
Live streaming	100K	NA	NA	
Live streaming	256K	NA	NA	
Video on demand	50K	+	+	
Video on demand	100K	+	+	
Video on demand	256K	+	0	Some sound delay

Symbols explain: "NA" – Not available, "+" Better than, "-" Poorer than, "0" As same as the reference streaming at minimum required quality.

## Videoconferences

A videoconference (VC) allows people at different locations, in real time, to see, hear and talk each other and also to share data for collaboration. For using VC there has to be equipped with ISDN picture phone system (through ISDN phone lines), or a personal computer configured with a web camera, a headset and compatible VC software (through the Internet).

VC is a real time interactive communication and collaboration either as a point-to-point connection between participants on two different locations or as a multi point connection between participants on three or more locations. A multi point

connection requires that each participant connect via a bridge or link. VC systems can use different types of communication links (ISDN and LAN the most used).

There are more advanced VC systems (for example, PictureTel [3] used at HiØ-IR, Norway) are based on dedicated broadband communication providing high quality video and used for room to room conferencing. These systems are not available at IRA and therefore will not be introduced for the current test. Hence, for the current test, VC is only defined as “a personal computer configured with a camera, a headset and VC software”. The systems based on standard desktop computers are using compressed video systems, which transmit information via Internet or telephone network. Furthermore, the test will concentrate on solutions through the Internet.

Internet based connections is by default using non-dedicated bandwidth which may cause poor quality video, but the low cost using these systems and the broadband Internet connections at IRA and HiØ-IR should give us the quality needed for these activities.

Using and connecting to others via VC is in many ways similar to placing a telephone call. The difference is dialling an IP-address, instead of a telephone number. Once you get connected you can see the other person(s) on the screen, you can talk to them and might also be able to transfer files or collaborate via document sharing or show-and-tell using tools such as a whiteboard and remote desktop.

### Student guidance and seminars

It was intended to test and recommend videoconference options (VC) for student guidance, research seminars, and other academic meetings online. The basic need was establishing a stable and reliable point-to-point connection between the exchanged students at IRA, Italy and the professors at HiØ-IR, Norway. Furthermore, VC will also be used for collaboration between students and for participating in seminars.

### Testing

There are quite few available software programs for videoconference solutions, and most of them are commercially based. The choices were many, but with detailed assistance from a student VC project group, the following 4 solutions were finally selected for the test: MS NetMeeting [4], VCON Vigo [5], CUSeeMe [6], and FlyConference [7]. All 4 solutions were pre-tested through the intranet at HiØ-IR with good results. Thus, the test from IRA, Italy is primarily a test of a remote scale.

There were however 2 client applications not being able to test:

- CUSeeMe: Not tested from IRA, Bologna due to problems with the central CUSeeMe server. This application is server based and is therefore not featured for a point-to-point connection. The required server is located in the US and it was down during the test period.
- FlyConference: Not tested from IRA, Bologna due to problems with local firewall. Ports 6000, 6001, 6003 and 3134 had to be open for this FlyConference application. There was however no access at the institute for opening these ports.

TABLE IV  
VIDEO CONFERENCE CLIENT TEST RESULTS

Client application	Price and Cost	Ease of Use	Video	Sound	Compatibility
MS NetMeeting	+	o	-	+	+
VCON Vigo	-	-	+	+	+
CUSeeMe	0	0	NA	NA	-
FlyConference	0	0	NA	NA	-

Symbols explain: “NA” – Not available, “+” Better than, “-” Poorer than, “0” As same as the reference videoconference (VC) at minimum required quality.

### Summary

There were major problems with the stability on all solutions; repeated restarts were common on different Windows systems (ME, 2000). In contrast, VCON Vigo offered by far the best quality of video. After a total consideration for both solutions, the final decision was still in favour for Microsoft NetMeeting. This was because of the MS NetMeeting’s competitive price and cost (free for Windows owners) and compatibility with open standards, though instability sometimes. The transitions to more stable systems and applications are important, but not crucial at this point. Using MS NetMeeting will require some training and troubleshooting skills before the students leave for IRA, but this solution will give us the means for student guidance, research seminars, and other academic meetings online needed.

## Web based courseware

Web based courseware is software designed to deliver training or educational courses [8]. The different courseware package aim at furnishing both the instructor and the student with an interactive, collaborative online learning environment that makes creating and teaching an online course obtainable to the "low-tech" teacher and student.

Most courseware packages have similar applications and functions, such as an automated grade book; communication tools, such as chat, e-mail, and threaded discussions; course templates to aid in course creations; and test and quiz tools. Some courseware packages can interface with existing campus computing systems and allow download and/or upload to campus registrar records.

## Virtual classrooms

Combined with streaming and VC solutions, web based courseware will be a powerful tool for building online learning communities. The essential dimension of this tool will be bringing together the different learning activities in one meaningful context, thus a virtual classroom. With these completed elements in an online infrastructure, the virtual classroom will work as the hub, linking discussions, videoconferences, live stream and video on demand, assignments, seminars and the course schedule.

## Testing

There are many web based courseware platforms available, and Learningspace [9] was one courseware package that used at HiØ-IR, Norway for 4 years, with currently 40 online courses served by this course package. In addition, an online direct chat courseware MOO/Encore [10] is used for synchronous courses and Authenticated User Community (AUC) [11] is explored as one of open source alternatives on a test schedule.

The different courseware packages are developed by different technologies. Learningspace is based on Domino databases, MOO/Encore depends on JAVA applets and AUC is based on MySQL databases and scripts. The test between these packages will be aimed to their key parameters: functionality and response time. These two key parameters were observed, measured and evaluated from IRA during the test stay. Furthermore, there has been tested to the bandwidth and response time with Trace route to get quantitative measurements to complement our experiences. The summary of test results is shown in Table V below.

TABLE V  
A SUMMARY OF COURSEWARE TEST RESULTS

Courseware	Functionality	Response Time	Notes
Lotus Learningspace	+	0	In production
Authenticated User Community	0	+	Test install
MOO/Encore	-	+	JAVA VM

Symbols explain: "NA" – Not available, "+" Better than, "-" Poorer than, "0" As same as the reference courseware at minimum required quality.

## Summary

All courseware packages worked well as the plan expected. The average response time was good and the bandwidth available proved to be enough. The open source packages worked properly, so it could be a real alternative for lecture delivery to IRA. There is however a need for further tests for the package and more users' experiences to this option. For the current project, the courseware of Lotus Learningspace is still the stable and convenient one the most HiØ-IR users, so it is still a fixed online environment for web based courses [12] for many users.

## RECOMMENDATIONS

Throughout the test, observations and reviewing the test results, there may be answers for the research questions in the introduction section:

- Is it possible to deliver the variation in learning activities needed for serving our exchange students at IRA?  
The current test and results suggest a combination of streaming, videoconference and courseware to deliver the distance lectures to the students at IRA, for crating a variation in this online learning environment.
- Is it possible to deliver the stability needed for ongoing courses?

The test showed the stability varied with the different activities; live stream and video on demand were stable. The same were the courseware packages when the required plug-ins was installed. Videoconferences (VC) were unstable, and MS NetMeeting seemed to be the most convenient one, considered by functions and costs. The use of VC needs however proper training and sufficient troubleshooting skills, and it may recommend to use point to point communication.

- Are we able to integrate the different elements to one meaningful learning environment?  
It is possible and technological solutions are there, thus using the virtual classroom as the hub, linking discussions, videoconference, live stream and video on demand, assignments, seminars (e.g.) and the course schedule. The success criteria and challenges are nevertheless the individual teachers and mentors facilitating to their course, online.
- What technologies and solutions should be used?  
It appears to be a good solution to use Quicktime application for live streaming and video on demand for lectures (free cost and stability). Using Microsoft NetMeeting for student guidance and seminars seems to be a convenient option for the most. For reducing the learning curve, it may be a good idea to recommend the current courseware Lotus Learningspace for creating virtual classrooms.

As a general conclusion and recommendation for further uses, the need of stability and reliability shall be the essential criteria for selecting and using of picture-phone solutions for the remote scales.

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