Implementation of Information Technology and a Computer Network System for Distance Learning in Hydropower E&T

IEA Technical Report

IEA Hydropowe
Agreement


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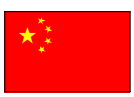
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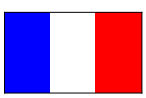
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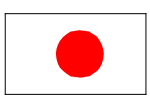
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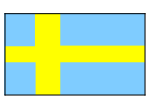
SWEDEN


UNITED KINGDOM

OVERVIEW OF THE IEA IMPLEMENTING AGREEMENT FOR HYDROPOWER TECHNOLOGIES AND PROGRAMMES

The Hydropower Implementing Agreement is a collaborative programme among nine countries: Canada, China, Finland, France, Japan, Norway, Spain, Sweden and the United Kingdom. These countries are represented by various organizations including electric utilities, government departments and regulatory organizations, electricity research organizations, and universities. The overall objective is to improve both technical and institutional aspects of the existing hydropower industry, and to increase the future deployment of hydropower in an environmentally and socially responsible manner.

HYDROPOWER

Hydropower is the only renewable energy technology which is presently commercially viable on a large scale. It has four major advantages: it is renewable, it produces negligible amounts of greenhouse gases, it is the least costly way of storing large amounts of electricity, and it can easily adjust the amount of electricity produced to the amount demanded by consumers. Hydropower accounts for about 17 % of global generating capacity, and about 20 % of the energy produced each year.

ACTIVITIES

Four tasks are operational, they are: 1. upgrading of hydropower installations, 2. small scale hydropower, 3. environmental and social impacts of hydropower, and 4. training in hydropower. Most tasks have taken about five years to complete, they started in March 1994 and the results will be available in May 2000. To date, the work and publications of the Agreement have been aimed at professionals in the respective fields.

UPGRADING

The upgrading of existing hydropower installations is by far the lowest cost renewable energy available today. It can sometimes provide additional energy at less than one tenth the cost of a new project. One task force of the Agreement is studying certain technical issues related to upgrading projects.

SMALL SCALE HYDROPOWER

Advances in fully automated hydropower installations and reductions in manufacturing costs have made small scale hydropower increasingly attractive. The small scale hydropower task force will provide supporting information to facilitate the development of new projects.

ENVIRONMENTAL AND SOCIAL ISSUES

For some hydropower projects the environmental and social impacts have been the subject of vigorous debate. There is a need to communicate objective information to the public, so that countries can make good decisions with respect to hydropower projects. The environmental task force will provide such information on possible social and environmental impacts and on mitigation measures.

TRAINING

The availability of well-trained personnel is a key requirement in the hydropower sector. The training task force is concentrating on training in operations and maintenance, and planning of hydro power projects.

THE INTERNATIONAL ENERGY AGENCY – IMPLEMENTING AGREEMENT FOR HYDROPOWER TECHNOLOGIES AND PROGRAMMES

IMPLEMENTATION OF INFORMATION TECHNOLOGY AND A COMPUTER NETWORK SYSTEM FOR DISTANCE LEARNING IN HYDROPOWER E&T (Education and Training).

May 2000

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HYDRO POWER UPGRADING TASK FORCE (ANNEX 1)
Guidelines on Methodology for Hydroelectric Turbine Upgrading by Runner Replacement – 1998 (available to non-participants at a cost of US $ 1,000 per copy)

Guidelines on Methodology for the Upgrading of Hydroelectric Generators – to be completed in May 2000.

Guidelines on Methodology for the Upgrading of Hydropower Control Systems – to be completed in 2000.

SMALL SCALE HYDRO POWER TASK FORCE (ANNEX 2)
Small Scale Hydro Assessment Methodologies – to be completed in May 2000 (available to non-participants on request)

Research and Development Priorities for Small Scale Hydro Projects – to be completed in May 2000 (available to non-participants on request)

Financing Options for Small Scale Hydro Projects – to be completed in May 2000 (available to non-participants on request)

Global database on small hydro sites available on the Internet at:
http://www.small-hydro.com.

ENVIRONMENT TASK FORCE (ANNEX 3)
Survey on Positive and Negative Environmental and Social Impacts and the Effects of Mitigation Measures in Hydropower Development – 2000 (available to non-participants on request)

A Comparison of the Environmental Impacts of Hydropower with those of Other Generation Technologies – 2000 (available to non-participants on request)

Legal Frameworks, Licensing Procedures, and Guidelines for Environmental Impact Assessments of Hydropower developments – 2000 (available to non-participants on request)

Hydropower and the Environment: Present Context and Guidelines for Future Action
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Volume 2: Main Report
Volume 3: Appendices
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Guidelines for the Impact Management of Hydropower and Water Resources Projects – 2000 (available to non-participants on request)

EDUCATION AND TRAINING TASK FORCE (ANNEX 5)
(All of the following reports are available on the Internet at www.annexv.iea.org. Some reports may consist of more than one volume.)

Summary of Results of the Survey of Current Education and Training Practices in Operation and Maintenance – 1998 (available to non-participants on request)

Development of Recommendations and Methods for Education and Training in Hydropower Operation and Maintenance - 2000 (available to non-participants on request)

Survey of Current Education and Training Practice in Hydropower Planning – 1998 (available to non-participants on request)

Structuring of Education and Training Programmes in Hydropower Planning, and Recommendations on Teaching Material and Reference Literature - 2000 (available to non-participants on request)

Guidelines for Creation of Digital Lectures – 2000 (available to non-participants on request)

Evaluation of tests – Internet Based Distance Learning – 2000 – (available to non-participants on request)

Brochure
A brochure for the public is available. It is entitled "Hydropower – a Key to Prosperity in the Growing World", and can be found on the Internet (www.usbr.gov/power/data/data.htm) or it can be obtained from the Secretary (address on the inside back cover).

PREFACE

This report is the result of the work of subtask 5: “Implementation of Information Technology and a Computer Network System for Distance Learning in Hydropower E&T” of the Task Force on *Annex V: Education and Training,* which is one of four task forces of the *IEA Implementing Agreement for Hydropower Technologies and Programmes.*

The objective of the work in this subtask is to present technologies and concepts to be used in E&T efforts using Internet as the medium and enabling technology.

Annex V subtask 5 where divided into three different subprojects:

- Development of guidelines for production of simple digital lectures
- Development of a conceptual application for administration of distance learning
- Evaluation of three test cases of the technology

The first section of the report is a general description of the reasons for using internet-based technologies in training and education, the purpose of the different subprojects and their goals. In the first section we also present the solution and the results of the evaluation of the concepts and systems created in the subprojects.

Sten-Erik Björling
Subtask leader subtask 5
IEA Annex V

The views presented in this report do not necessarily represent the views of the International Energy Agency, nor of the governments represented therein.

SUMMARY

This report complements the work presented at the Annex V web-site at http://www.annexv.iea.org – a web-site containing examples of usage of multimedia as tools for presentation and lecturing and a conceptual application named OmnIES. OmnIES is a conceptual application created to demonstrate the abilities for the students and teachers to manage personal curriculums and content of training efforts using Internet-based techniques as tools. Additionally methodology for creation of simpler digital lectures has been developed, documented and tested. Luleå Technical University, Sweden today uses this methology in distance learning contexts.

During the work it became more and more obvious that Internet and Internet-based technologies offers great advantages and opportunities to optimize training efforts and exchange of knowledge. At the same time it also became more and more obvious that the current state of technological development in the Internet-sector produces solutions that are too demanding for most users needing to implement the technology. Another obvious conclusion is the lack of integration supporting an optimal exchange of knowledge and competence resources across the Internet.

The focus in the subtask thus where concentrated on creation of a simple conceptual tool to demonstrate the possibilities of "integration" for a student in a possible Internet-based education context. Another focus where to demonstrate the usage of new media types to be used in the educational context. Both these areas for development concentrated on creating solutions that allows for a large body of users to be able to use the technology without having to upgrade computers or connecting to fast communication links.

The conceptual tool developed in subtask 5 named OmnIES presents a conceptual implementation of a "knowledge navigator" for a student or a teacher. OmnIES as a tool allows for the user to navigate between a large number of educational resources and co-operate with colleagues and fellow students with low demands on computer hardware and communication links. The system offers high speed, low costs for deployment even for relatively large installations and also offers simple maintenance.

The work centered around the usage of digital media was concentrated on the creation of guidelines and recommendations for creation of digital lectures – slide presentations combined with voice presentable across low-speed modem connections. On the web-site there is a section presenting different examples of usage of different media types.

During the work in subtask 5 there where decisions to use the developed technologies in three different tests: Luleå Technical University and Jokkmokk (both in Sweden), Jokkmokk, Sweden and Sao Paolo, Brazil and Trondheim, Norway and Daar Es Salaam, Tanzania. Due to the loss of Dagfinn Lysne and the extended sick-leaves of key-personnel at JTC two of the testing scenarios could not be performed as planned. Nothing though in the technology used

or the methods implemented where found to present any obstacles in the possible implementation of the tests.

During the whole testing period the OmnIES application server and the different services has been running without complaints or problems (except 2 mistakes from the administrator that demanded re-starts of the complete server system). The performance of OmnIES in its current incarnation allows for handling of the “knowledge navigation” for schools presenting loads of hundreds of simultaneous users.

INTRODUCTION

This report covers three different subprojects part of Annex V subtask 5:

- Development of guidelines for production of simple digital lectures
- Development of a conceptual application for administration of distance learning
- Evaluation of three test cases of the technology

In addition to these subprojects covering the conceptual system for internet-based distance learning the task of creating and managing the Annex V web-site has also been a responsibility for the subtask. The URL for the web-site: http://www.annexv.iea.org.

The first section of the report is a general description of the reasons for using internet-based technologies in training and education together with examples of implementation. In the second section we present a concept presenting simpler solutions for the problems presented in the first section. In the second section we present the components of the conceptual system presenting a viable solution – the OmnIES application and the usage of digital media.

The third section presents the planned tests and the outcome of the tests. Finally it is presented some recommendations for future efforts.

Background

Internet has grown to be one of the most important infrastructures for human co-operation and development and that trend will continue in the future. And one of the most important areas of expansion for the usage of Internet is education and exchange of competence. And that in a world in which humanity has to be more and more creative and efficient in its implementation of innovation due to faster change and greater stress on the limited resources.

Vital factors in these contexts are education, training and competence exchange to shorten the time between encountering the problems and implementing solutions. Ultimately the goal for an education and training system is to make it possible for the future generations to stand on the previous generations shoulders, not their toes… And a vital part of that optimal future will be based on intelligent management of competencies and training efforts.

But the main problem today is the uneven distribution of the capabilities of the Internet infrastructure – most countries do not have access to the Internet with high-speed connection links and within the different countries the population to a large extent does not have access to Internet as an infrastructure. The solutions available to the current “top-notch” countries like USA and the European countries are not feasible to implement at a larger scale – the quality and speed of the communication links does not allow that. The question at hand is to find a “middle-way” solution that will offer most of the advantages of an Internet-based education framework without demanding too much advanced and expensive equipment and large demand for specialists.

The work in Annex V subtask 5 has been to test and evaluate such an “middle-way” type of solution in the conceptual form.

WHY INTERNET-BASED TRAINING AND EDUCATION?

Advantages of an internet-based system for education and training.

Basically the utilisation of Internet-based training and education can be based on these factors:

- Low cost of distribution of learning materials
- No time-zone limitations
- Allows for distributed production of learning materials.
- Allow for relatively easy customisation of personal curriculum
- Allow for simpler creation of local "adjusted" curriculum's

Internet allows for low-cost distribution of learning materials and training sessions. Once the material are produced it can be distributed without limits to as many users as possible. The distributor does not need to maintain a large supply organisation and the materials can easily be modified to respond to changes in demand without having considerations covering a large stockpile of materials being obsolete. The materials can be modified at any time and the modifications can immediately be available to the users across Internet.

Internet allows for participation in lectures regardless of time zones or mandatory training within a strict schedule. This allows for training sessions to take place at times and in locations otherwise not considered - participating in training sessions as a mandatory part of the ordinary work schedule held by specialists in different areas is both possible and recommended. Training can more than ever before be used to create the "learning organisation" where employees continuously can participate in training when work-load and responsibilities allows it.

Internet allows for distributed production of learning materials, lessons and whole courses across the whole world. Due to the ability to access storage of materials across the world-wide covering Internet the production of a course or training can be delegated to many specialists across the world. When the amount of material increases the production of training materials can more or less be in the form of picking elements from a "smorgasbord" of lessons, learning materials or pre-made specialised courses.

Internet combined with administrative tools allows for the creation of a "personal curriculum". Training can be customised by the user or the responsible managers into a personal curriculum for the individual. This customisation can be based on the priorities or needs of the organisation, the individual or both.

The courses can quickly be created by specialists from different parts of the world and thus can contain highly specialised lessons. A course can be built up from selecting different learning materials in the form of documentation, digital lessons, movies, web-based media and contact information. This allows for creation of courses and lessons customised for specific problems and the learning materials can quickly be adjusted for new conditions.

EXAMPLES OF USAGE OF AN INTERNET-BASED SYSTEM FOR EDUCATION AND TRAINING.

Below are presented five different uses of an internet-based distance learning system for different types of users/students. For each of the types of users a scenario is presented that demonstrates the usage of an internet-based system for education and training.

The uses/scenarios are:

- Complementary training of existing personnel.
- Higher education – college and university levels.
- Distribution of lessons and learning materials for non-electronic training sessions.
- Interface training sessions for specialists.
- Support systems for facility management and support of advanced technical equipment.

Complementary training of existing personnel.

This is one of the most important training types in the future. Mostly this is dependent on the ever-increasing complexity of both equipment and dependencies in the societies. It will always be a fact that most of the employees have been a long time in the organisation and that their knowledge in the areas of work needs continuos updating. But creating programmes for this type of training is not simple – the clients are often needed in the production process and co-ordinating the training schedule for this type of clients are often hazardous. Another problem is the large variation in knowledge levels amongst the clients that makes it difficult to create efficient training sessions – it is an advantage if the clients could “synchronise” their knowledge-level before participating in those sections of the training effort that are more complex.

A training system for this type of training must take into account the large variation of training needs of the clients and ultimately their organisations. And the need to gather useful content from different parts of the world into training sessions will increase – exchange of experiences and knowledge around common themes like sedimentation problems or different types of equipment will increase in the future. And one must be able to swiftly compose these training sessions according to changed demand.

A system based on Internet and modularised training together with improved communication between the suppliers and the clients of training will enhance the ability to adequately handle these changed needs. This can be achieved by:

- The clients can evaluate their need of training by testing their competence levels – this step can be co-ordinated with certification testing. Another approach is evaluation talks between the clients and their managers.

- From the results of this testing the clients can list the training sessions that at large represents their training needs and both evaluate the cost and the time needed to perform the training. The choices that the client makes in this step constitute the client’s “personal curriculum”. The content of this personal curriculum can contain modules from all over

the world and also materials from suppliers of the equipment used in the areas of work of the client.

- Every module in the personal curriculum is built up by a number of courses or lessons. Some of these lessons are introductionary and can be performed as a whole locally using Internet as a transportation medium for both the lessons and other learning materials. Even simpler testing can be performed across the Internet. This type of training can be performed at work using specialised computers or the clients own workstation and even from home if the Internet access and local policies allows it. The training can be performed in the same way as for George in the example covering higher education.

- Several of the training sessions are complex and demands access to lessons held by specialists in their respective field. An Internet-based system can simplify these training sessions by allowing for the clients to prepare properly and in an organised manner document questions and requests for detailed descriptions not found in the basic learning materials. These questions and requests can be used by the teacher to further improve the content of the training.

Higher education – college and university levels.

The future education at higher levels will more and more be able to use Internet-based components in the training sessions and exchange of information and experiences. Let us share a scenario with you – George Knowhow studying higher levels of construction and design.

At the start of the training George checked out a portable computer with a standard configuration containing all the software for interaction with the educational systems on the campus. The portable only contains the users own documents and the applications with a backup on the central server. The portable communicates wirelessly with the computer network on the campus containing all the learning materials and administrative information. The consequence of this is that George can be everywhere within the campus and participate in digital lessons or perform labs together with others.

The courses that George participates in as part of his education are assembled by a large number of learning materials produced in many parts of the world. The responsible person for a course can choose learning materials like digital lectures, course documentation, labs and tests from servers all over the world - what matters is the quality, the adequacy and the price levels of the learning materials. A teacher can even pick different parts of learning materials into their own lessons - a good description of the functionality of a specific type of turbine created by a university in Canada can be followed by a good description of cavitation with video presentation created in Sweden. The key factors here are the administration of the rights of the materials and compensation agreements.

George starts the day by checking the schedule for the day - the mandatory lectures that are not recorded or the ones that he wants to participate in "in situ". George's schedule do also contain recommended participation's in digital lectures - recorded lectures produced locally or lectures held in other parts of the world by specialists that are recorded and present on the servers. George goes to the library and connects the earphones to the computer and chooses the first digital lecture. The digital lecture is presented in the upper part of the screen and George pauses the lecture now and then to repeat difficult areas and revise the questions/answers that other students/teachers has posted on the specific lecture before him.

After the lesson George has the opportunity to perform a test on the material and that test does also contain questions from earlier performed lectures and labs. George can perform the test several times but the test will be more difficult for each try and certain mechanisms built into the testing environment prevents him to map the questions - amongst the most efficient is degradation factors for each test he performs.

The digital lecture that George participates in are split into several sections - mixed with the digital lectures are references to documentation, URLs for the Internet, email addresses, customised newsgroups and digital labs. These sections must be covered in a specific order. The laboration part for George is a system dynamic model of the performance of a turbine when changing parameters like flow, speed and properties of a turbine installation. George has to successfully create a model that demonstrates the functionality of the installation - the generated model is evaluated by the responsible teacher for that specific part of the course that is stationed in AIT in Bangkok, Thailand. All this is performed without cable connections

and can also be performed in the student's home or his parent's home as long as he has access to an Internet connection.

Distribution of lessons and learning materials for non-electronic training sessions.

The example covering higher education above is not always achievable due to budgetary constraints. An Internet-based training system can despite these limitations also be of good use for simpler installations - the client in this type of system is teachers, not students.

Most parts of the learning materials are still usable for teachers - the digital lectures can be accessible through ordinary presentations with textual guidelines, the documentation can be printed out and distributed manually and the labs can be based on textual instructions and correction instructions. An Internet-based system could also be a very good infrastructure to handle complementary training for teachers and instructors - in this type of system those teachers and instructors are regarded as clients in this type of system.

Mr. Smith is a teacher in Nepal, a country that do not have access to the most advanced high-speed network technologies. This inhibits the possibilities for him to interactively use the materials as George can do in the example covering higher education above. Mr. Smith can download the presentations and instructions in PDF-format, perform the digital lectures himself to update his own knowledge in the areas and also download and distribute the documentations for the course. The digital lectures is printed out on OH. The tests can be printed out for all the students in the class together with one copy of the correction instructions for the test. Each printout of test and corrections are unique.

During the course Mr. Smith have access to all the resources in the form of email-addresses for the competencies and the forums in the system. The more demanding materials like movies and large demonstrations (or recorded live lectures) can be delivered with CD-ROM or DVD-RAM (allowing for really large files). Most of the courses if using standard technologies will fit into below 30 Mbytes - it is possible to distribute whole courses on a Memory Stick from Sony.

Interface training sessions for specialists.

Increased specialisation of competencies and the ever-increasing complexity of the society increase the needs for personnel in planning and management positions to swiftly update their knowledge in areas different from their previous studies. New mixtures of competencies will be needed and these mixtures will mostly be developed due to localised, special needs.

This scenario will demand so called “interface training” – introductionary training to learn the basic terminology and simpler solution methods of a discipline. This type of training shall more be regarded as an “synchroniser of terminology” which will allow for more efficient communication between specialists in different fields. Being able to ask the right questions to other specialists and being able to co-ordinate efforts to create solutions will be more and more important in the future.

Mr. Johnson, Mr. Anderson and Mrs. Roland are three specialists in three different areas. Mr Johnson is a specialist in dam construction, Mr. Anderson is a specialist in hydrology and Mrs. Roland is a specialist in water supply systems and environmental issues. The task at hand for this group of people is to evaluate the consequences of an extension of an existing dam and evaluate how to perform the extension and in the same time improve the handling of the water supply to the surrounding urban areas.

The first step for these three individuals is to participate in "interface training". Each area of discipline is vastly different from the others and no one of the members in the group has participated in any education in the other members discipline. Mr. Johnson performs the interface training for the areas hydrology and water supply systems, Mr. Anderson performs the interface training for the areas dam construction and water supply systems and Mrs. Roland performs the training for dam construction and hydrology. The goal of these "interface training" sessions are to present to the client the most important terminology and an introduction of the "modus operandi" for professionals acting in similar roles of the members in the project group.

After the interface training the different competencies hopefully are more able to communicate with each other, better aware of how to see things from the viewpoints of the other participants.

Support systems for facility management and support of advanced technical equipment.

The equipment used in the power sector is becoming more and more complex and do also demand more and more interactions with external infrastructures in the surrounding societies. There exists a need to keep the support personnel (both internal and the personnel employed by the customers) updated regarding new installation routines, error checking and standard maintenance.

The best solutions would be the ones integrating the standard administration routines like orders, logistics, planning and analysis with a system containing the instructional materials for the equipment managed in the facility or amongst the customers. This demands direct connections between the systems managing the instructional materials and the other administrative systems - mainly the order system and the facility inventory systems.

Mr. Levitt is a maintenance engineer at a hydropower station in Norway in the process to evaluate how to change some technical equipment in the generator to increase yield and longer the life of the present generators. The responsible engineer from the company supplying the equipment sits with Mr. Levitt to evaluate different scenarios of delivery - the representative is directly connected to the production and warehouse systems of his company. For each main item in the process of the installation one can directly evaluate the time consumption for the installation and the needed training of the personnel in the facility. At the same time as the order is created for the installation a training package is created that can be downloaded from the company server or stored on DVD-RAM. Before the shipping of the equipment starts the facilities own personnel can be updated on the needed preparations for the installation.

CONCEPTS OF A SOLUTION - OMNIES AND DIGITAL MEDIA

The created solution is a conceptual study - all the possibilities that are present are not included in this simple system. It is important though to emphasise that the system is highly scalable both in functionality and performance. The system consists of two main parts - the OmnIES administrative system and digital learning materials - both handled by the same server hardware.

Overview of the OmnIES set-up

The server has a Intel server motherboard, a single processor Pentium III 450 MHz, 9 GBytes UltraWide SCSI disk (no RAID), 100 MBit Ethernet and 256 MBytes of memory. No modifications of the standard settings for the network and no modifications have been done to the quanta setting for the scheduler in NT. The server is optimised for network services and runs distance administration software as a background service.

The server can easily be upgraded with a second processor or two more powerful processors, more memory and advanced RAID systems if that is needed.

Below is presented the different server-processes that are building up the OmnIES server for this project. All these processes are handled by the server hardware described above. When the load increases these different services can be placed on several servers and the services for DB2 database server, web server and Omnis Web Client server can be clustered for really large installations.

In addition to the OmnIES system the server do also handle the WebX system. WebX is a web-based conference system that is used by the conference part of the Annex V meeting place. It is a web-based conference system that allows for interaction between individuals and exchange of information and files.

OmnIES

The role of OmnIES in the system is to be the “administrative assistant” for the students participating in the courses. The system keeps tabs on what courses each student is registered to, the lessons in the courses and all the learning materials for the courses/lessons. OmnIES allows for the management of “personal curriculum’s” for the students, and each curriculum can be different from the other students.

Another role for the OmnIES system is to enhance the communication between the participants in the courses – both teachers and students. OmnIES can act as an “accumulator” of questions and answers for the different parts of the courses and thus become matured into a “knowledge bank” as time evolves. Most of the time the students do not need to ask a teacher – they can read the earlier answers to the questions asked and if their own question gets its answer from this “knowledge bank” the workload of the teachers lessens.

The components of the OmnIES system

OmnIES consists of several parts - several services handled by servers and client components in the users browser. This conceptual test-installation also uses a powerful database-server with a test database that has been constructed to measure how the system will react in "real-world" situations.

OmnIES application server

The OmnIES application runs as a service at the server and is responsible for the applications logic and interaction with the user interface present in the browser at the user. OmnIES optimises the transfer between the server and the client to be as small as possible to keep up the performance. The current demonstration license for the server is for 100 simultaneous users available until last of March 2000.

DB2 Database server

The DB2 database server is responsible for the datahandling in the system. The license used is the Personal Developer Edition, which is free from IBM - no impact on the functionality and performance in this system though. The dataserver is loaded with test data covering about 5 000 students, 200 courses, 3000 lessons, 9000 learning materials and about 100000 chat forum entries together with other data. The purpose behind the test data is to present for the developers and test users of the system the performance levels that are obtainable for a larger installation. The database in the OmnIES system is optimised by using the normal indexing tools and updating of the statistics of the database. Triggers, views or optimised servlets are not used. Other settings for the server are no record locking, handling of 1500 local connections, 10000 bufferpool blocks. We will re-evaluate these settings before year's end (decrease the local connections and increase the number of bufferpool blocks). The DB2 server can be clustered to really large installations and its command set for handling of statistics and summary data is really powerful.

MS IIS Web-server

The web-server handles several tasks - it handles this web-site, is responsible for the distribution of the data between the OmnIES application server and the clients in the system and is also responsible for distribution of the learning materials to the clients in the system. The consequence of this is that the server might slow down significantly at high loads - a real installation for several hundred or thousands of simultaneous users demands different system architecture.

The client software in OmnIES

The client software is the software used by the users of the system – in this case the individual students and teachers. The client software is a web browser (either Internet Explorer 4 and higher or Netscape Navigator 4 and higher) using a plug-in for handling the connection to the OmnIES server. The plug-in is installed once and for all – it updates itself with new versions

and can also update itself with new functionalities when needed. After the first install the user does not need to interfere with new installations or updates.

One big advantage using Omnis Web Client is that all communication taking place within the client software and the central server can be encrypted. That allows for safe transmission of data between the users of the systems and the server. Another advantage is that the code behind the solutions is safe from hackers – no code handling business logic is handled at the client but is handled at the server. Potential hackers do not even have access to the calls to the central routines at the server.

Another advantage using a plug-in of the type that OmnIES does is freedom. At first installation of a plug-in seems to inhibit freedom but it turns into a good choice in the long run. The reason for this is the on-going strategies from vendors to “kidnap” the html-standards for their own purposes. Another big advantage is that the need to continuously updating the web-browsers to get access to the latest patches diminishes. Instead of a download and installation of a plug-in that is no larger than 100-300 kBytes one will need to regularly download and install new versions of the browser and its components. And those installs are much bigger and disrupts the usage pattern of the users even more than the one-time install of a plug-in.

The Omnis Web Client software allows for fast and efficient solutions using browsers as the interface and allowing for easy maintenance of the solutions. Since one very powerful server can handle up to 1-2000 simultaneous users and only one copy of the solution needs to be updated for all the users on that server the maintenance is greatly simplified.

System load and simultaneous users

Depending on the usage pattern of the users this simple conceptual system can eventually handle 3-400 hundred simultaneously active users with the present hardware described above. Most of the time the users are not creating any load to speak of in the OmnIES and database parts - most of the load is generated for the web-server that has to handle all the distribution of the learning materials. By separating this part from the server the capacity increases. An upgrade to Linux from NT will probably increase the ability to handle users to about the double on this specific hardware. Separating the different services to different servers will also increase the performance and abilities of the servers in the system. Separating the web-server part to a set of different servers and using streaming media allows for a large amount of users (several thousands) to participate in lectures at the same time. MacOS X Server can today with a standard server license and good hardware support 1-2000 simultaneous users on one server (28 kBaud connections) - and the server software costs 500 USD as a one-time cost. As a comparison Real Software offers the same type of server software for 40 000 USD a year.

DIGITAL MEDIA - FORMATS USED

Another key component in the system is the digital media. As far as possible we are using standard formats for the digital media - PDF for documents, QuickTime for close to all other media like graphics, lectures, sound, movies and streaming media.

PFD

PDF is a format created by Adobe for distribution of documents across platforms and distribution media. Readers for PDF-files are present on close to all platforms and versions of operating systems. The files can be read directly in a web-browser or stored locally on a disk and read by a reader that is free to download from Adobes web-site.

The PDF format is responsible for the following types of digital learning materials in the system:

- Standard documentation of the courses. These documentations can be stored in optimised formats for screen presentation or for printouts.
- Laboration instructions and general information used in the courses (short to all text-based materials).
- Originals for the lectures that are to be distributed in areas where one cannot count on working computer networks or advanced presentation equipment. Distribution of whole courses to teachers in developing countries is an example of this category.
- Printouts of drawings and schematics for plants and equipment.

A question that has sprung up during the development of the concept is why we do not use the Office-based formats for the learning materials. The reasons for this are:

- The formats in the Microsoft Office-suite is changed often to lock-in the users within the Office environment - that makes the formats in Office a bad choice when standardising the documents over time.
- The numbers of different Office formats are increasing and make it difficult to create meaningful standards. Not all users in the world are using Office 2000.
- The modern formats in Office demands a lot of disk-space - with the introduction of Office 97 the size of even simple documents has grown significantly. This corresponds directly to increased demands on the network bandwidths.
- The modern Office formats introduces a tremendous increase of the exposure to viruses. Office-based macro-viruses are introduced in the pace of hundreds each month and they get more and more capable to create total havoc in the users systems.
- The modern Office formats creates and maintains unique identifications in the systems and do also contain vital information covering the users system that simplifies advanced virus attacks and illegal surveillance.

QuickTime 4

Apple QuickTime is the standard for multimedia today on the Internet. QuickTime is the only product that uses common standards, covers close to all multimedia types and that can be used freely. With version 4 QuickTime handles streaming media that prevents free copying of materials and with version 4.1 the developers also can connect the usage of the media to external systems for billing etc.

QuickTime is responsible for the following types of learning materials in the system (a subset of uses):

- Digital lectures, with or without enhanced animations or included video sequences.
- Movies of different types (except Real Networks and some Microsoft formats).
- Recorded lectures handled as streaming presentations.
- Real-time distribution of lectures - demands broadcasting server software and powerful computers.
- All picture, sound and animations in the learning materials.
- Handling of virtual presentations of 360-degree scenarios (like dam surroundings) or presentation of components (user can swivel around the component to inspect it from all angles).

The choice of QuickTime was a simple one due to the following factors:

- The quality of QuickTime's handling of media is regarded to be the best in the market.
- Most media that is produced for the Internet is produced in QuickTime. Even most of the material that is played in RealPlayer is produced using QuickTime-based tools and only the last compression step is made for Real Networks players.
- Microsoft Media Player has advantages like support for many formats and widespread installed base (standard player in modern Windows versions). But Microsoft does not follow the standards created in the market and modifies the formats for own political purposes. That makes it difficult to use the solution when it has to be stable over time.
- Real Networks formats are widespread but the support of other multimedia formats than their own is weak.
- For both Real Networks and Microsoft the server licenses for handling large numbers of streaming media users is very high compared with QuickTime. Server software for handling 2000 simultaneous streams across 28.8 modem costs as a single payment 500 USD for MacOS X Server - the yearly fee for that capacity is 40 000 USD for a Real Networks solution.

DIGITAL MEDIA - EXAMPLES OF USES

The system builds on the usage of several types of learning materials based on multimedia formats like movies, animations, sounds and pictures. Below are described some main types of learning materials and their usage of multimedia types.

Digital lectures. The digital lectures can be constructed to include most of the components that are contained in a normal presentation including the lecturer if the bandwidth allows it. The components can be pictures, sounds, speech, video, presentation of the lecturer and animations. Another component is interactivity – the student can navigate in the lectures different sections and can also perform multiple choice tests. The limitations here are the knowledge levels of the producers of the lectures, the amount of bandwidth that the lecture can demand and the time for the production. The more advanced components used the longer the production will take.

Recorded lectures. This type of lectures can be broadcast in real-time and in the same time recorded and prepared for archiving in the system. This type of lectures are relatively easy to produce but cannot contain more advanced components like more thoroughly prepared illustrations and inclusion of navigational elements into the lecture is more difficult.

Documentation with pictures and VR presentations. The digital media can be presented with close to all the standards that exists for pictures. Amongst those are the most important jpg, gif, png and tiff. A presentation can also contain VR-presentations (VR = Virtual Reality) based both on photographs, pixel- and vector graphics. Examples of such presentations are 360-degree panoramas presenting the surroundings of a dam or “walk-around presentation” of large components. Since parts and sections of these presentations can contain buttons for commands and navigation the user can explore the objects presented. The most advanced uses of this technology could be control room simulation – by going to the control room panels and perform actions the user can obtain consequence descriptions and detailed lectures.

Animations. The presentations and learning materials can contain animations based on vector graphics that does not demand a lot bandwidth or storage capacity. The animations can also be combined with button areas and simpler programming to create simple simulators.

Sound. Digital lecture materials can contain sound in many different forms. The most used type of sound in the lecture materials will be speech, other types are sound recordings of higher quality and music performed by MIDI-based instruments. The main reason for us being able to squeeze in speech together with presentation materials in the digital lectures and still being able to distribute it across 28.8 modems are the strong compression algorithms in QuickTime.

OTHER TYPES OF LEARNING MATERIALS

The Internet/computer network allows for an even broader interpretation of what is a learning material. Below are some samples of more unconventional learning materials.

Forums. The difference between forums and a combination of email and standard newsgroups used across Internet is that each item in the forum can be directly linked to parts of lessons or courses. In this sense the forums represents a long-term memory of all the questions of importance and comments associated to a course or lesson.

Internet-based resources - URL-based. URL = Universal Resource Locator, the unique address to a specific resource in the Internet. In this group of learning materials are newsgroups in specific areas, content of mailing lists, web-sites and ftp-sites for file storage. Another learning material in this context is the email address to teachers and specialists and the URLs for the video conferencing equipment used by these individuals.

Terminal sessions. This group does not only contain the standard terminal connections that can be used in programming labs but also Windows Terminal sessions. Windows Terminal sessions allows for the user to use applications running on a Windows server across the internet – it is possible to perform labs and tests that use regular Windows applications like simulators and CAD-systems.

Text- and document databases. Being able to search large amount of information regarding a subject will be more important in the future. Today much of the information is stored in heterogeneous systems that demand a number of different tools to find and present information. Databases that are specialised on storing and handling of texts and documents allow for fast and accurate searching of information and the exporting of that information into standard formats.

RESULTS

Training Hydrostatics Luleå - Jokkmokk, Sweden

Below is presented the report from the responsible teacher at the course in hydrostatics (university level). Comments from the subtask leader for subtask 5 are also presented.

Report from Hans Åkerstedth, teacher, Luleå Technical University:

The internet-based learning technique presented in this report has been utilised in two different courses both presented for the students in the Hydropower engineering education program at Jokkmokk, Sweden. In the first course, a course in hydromechanics there was eight students. In this course the net-based learning technique was used as a complement to ordinary classroom teaching. The theoretical part of the course was given in a series of digital lectures covering the whole course.
As a teacher using net-based learning the main part of the work is the development of course material suitable for presentation over the internet. In this course the material was first presented in a series of PowerPoint pictures. To each picture the corresponding sound was recorded, and finally Quick Time was used to synchronise pictures and sound into a movie.

The reaction from the students about the content of the digital lectures was not very enthusiastic. They felt that in the lectures too much emphasis was given to derivations of formulas and that too few examples of practical applications were presented. The conclusion is therefore that the course material presented is not sufficient and certainly needs to be complemented by more examples and practical applications. It is important to note that the main criticism of the digital lectures was directed towards the content of the lectures. The attitude among the students of net-based learning in general was, with a few exceptions, rather positive. They think it provides a good complement to ordinary classroom teaching, and especially the possibility of repeating the course at home and at any time of their own choice was appreciated. So with a well-prepared course material digital lectures could replace some of the ordinary lectures. These lectures must however be followed up by classroom lectures with a teacher at place, helping the students solving exercises.

The students were also quite satisfied with the technical quality of the digital lectures. The dominating number of students (75%) found the technical quality of the pictures to be good. The quality of the sound was not entirely satisfactory, only 50% of the students were satisfied.

In the second course, a course in Fluid machinery, another pedagogical approach was used. Here a teacher at place in Jokkmokk gave a few introductory lectures. These were then followed up by internet-based presentations of solved exercises. To each problem a short summary of the relevant theory needed was presented, which was followed up by a solved exercise. This part of the course was therefore completely replaced by internet-based teaching.
This course is not finished yet and is therefore too early to document.

Comments on the test Luleå Technical University - Jokkmokk

The comments are made by the subtask leader for subtask 5, Sten-Erik Björling.

The digital lectures that where produced for this test was optimised for fast production by personnel without experience in producing multimedia learning materials. The consequences of this are the following:

- No animations or graphical objects pointed out for the students which parts of the complex presentation was described in the spoken presentation. This made it more difficult for the users to follow the lecture.
- No interaction was present in the lectures which would take more time and experience to implement. No effort was made to optimise the pedagogical management of the different media due to budgetary and time constraints.
- The speech was highly compressed to allow for use of the lectures across 28.8 modem connections (2500 bytes a second). If the users did not use earphones while participating in the lectures the speech became diffuse. One can always evaluate less compression, which gives higher quality but puts higher demands on the bandwidth of the connection and the server performance when many users are connected.

The goal of this subtask is not to evaluate the best pedagogical methods and functionalities in learning materials distributed across the Internet. We have proven though that a system designed like the conceptual study can handle enough data-transfer to allow for usage of more advanced learning materials like animations and simpler simulations.

Test session Jokkmokk, Sweden - Sao Paolo, Brazil

Due to sick-leaves of key personnel this test was postponed and later cancelled. The ambition and present plans sets the execution of a more thorough test in a commercial context during the summer and autumn of year 2000.

Test session Trondheim, Norway - Daar Es Salaam, Tanzania

Before this session was planned to be started Professor Dagfinn Lysne died. Professor Lysne where the individual responsible for co-ordinating the initial efforts behind the test and the work with setting up the test where because of this delayed. When the work with the preparations later was started we found out that the time did not allow for a testing period sufficient for the work in Annex V subtask 5.

During the preparations that where done a smaller training session where performed demonstrating the production of digital lectures. The comments and suggestions from that training shows that it would be possible according to the responsible personnel to create materials for the training’s in Tanzania and perform parts of the training using this type of technology.

Usage of OmnIES

Due to the circumstances presented above covering the tests between JTC-Brazil and NTNU-Tanzania no tests of the OmnIES application could be performed as planned. During the period though the system has been used by at most 20 simultaneous users, handing loads of 10 000 hits during 2 hours (represents a real-usage pattern from 1-200 simultaneous users) and has been running without interference from the administrator for at longest 2.5 months. The system has though been taken down for some maintenance work covering the Windows NT operating system. The performance of the system has been high during the whole usage period and no memory-leaks has been identified.

RECOMMENDATIONS FOR FUTURE WORK.

The concepts and solutions created and tested in this subtask points out interesting possibilities and also points out weaknesses in the current usage of Internet as a distribution medium for training and education.

To rely on the Internet in its current with simple web pages, newsgroups and email in training efforts presents the following weaknesses:

- It is difficult for the users to evaluate the alternatives for the training effort. To assess the available resources a user has to navigate and search information amongst a large number of sources, each one with its own structure and definitions.

- To find information covering a certain research area the user has to be very knowledgeable in both the usage of Internet-based tools and where to go for finding information. It is difficult as a manager or higher executive to assess what research is available to help solving the problems at hand.

- The current structures are “vendor-based” in that they only presents the current offerings based on the vendors for the courses and solutions. A more efficient way of solving problems are to become more “problem-based” resulting in the ability of the users to choose competencies and solutions to help solving the problems at hand regardless of vendor.

These problems demand a new way of looking at the methods to distribute knowledge using Internet as a media with adequate tools. Using the standard tools in Internet is not enough to handle the increased demands for functionality. An extension of the presented work in Annex V subtask 5 would be to create examples of such enhanced tools for better competence management in the international scene of hydropower.

Such a system could be named Hydropower Competence Network (HCN) and could contain the following main components (amongst others):

- A “competence navigator” for participants in courses – a more developed version of OmnIES.

- A tool for course composition using existing learning materials and courses from different training facilities around the world.

- A tool for co-ordination of course development between different schools and training facilities – for customised creation of training efforts. Creation of new types of learning materials and courses could be delegated amongst several training facilities across the world.

- A tool for presentation of research results. As a part of the thesis the researcher can create two specialised digital lectures presenting the thesis – one lecture presenting the results for the layman and one for presenting the results to a knowledgeable specialist. In this manner the research results have a greater probability to be used to solve real-world problems as fast as possible.

All these different components should be handled in one common interface to simplify the usage and minimise the training efforts for the users. But it is also important that the system is not centralised – models for distributed responsibilities should also be tested and evaluated. Otherwise the users of the system would be hesitant to make contributions to it relieving himself or herself control of vital information to a single external vendor or organisation.

Appendix A: Handbook for creation of internet-based presentations

Background

This instruction is created as a part of the work in IEA Annex 5 Subtask 5 covering Internet-based distance learning. The participants in the test installations in subtask 5 will mainly use it in the production of electronical presentations to be distributed over Internet. This documentation shall not be regarded as a final description for this type of production process but shall be regarded as a document constantly tested by the technical development in areas like multimedia and Internet.

The problem

Distance learning presents a number of problems for the creators of learning materials. One large obstacle is the bandwidth available for the distribution of the learning materials if the distribution is to take place over the Internet or modem-based communications. Another is the paradigm for the training – usage of literature in combination with email or conferences, videoconferencing or digitally based presentations. This instruction is targeted at the production of digitally based presentations that will be using Internet or modem-based communication for distribution.

The main problems with digitally based presentations in this context are:

- How to efficiently produce the presentations.
- How to make the production as simple as possible – a teacher must be able to produce the presentations himself without the aid of specialists.
- How to simplify an effective organisation and technology for the distribution of the digitally based presentations.
- How to design the presentations in such a way that the learning process at the students end is optimised.

This handbook will cover the production, storage and some aspects covering the distribution of digitally based presentations. The section covering design recommendations are not covered in this handbook.

The solution – overview

Below are described the different parts of the concept for digitally based presentations and their production.

Storage organisation

An efficient workflow for the production of electronical presentations and lectures demands an efficient storage structure of the different materials that acts as building blocks for the presentations. If there is only one person working on the materials then the need for structured storage is less but most of the production of the presentations will be together with others.

At large one example of an storage structure consists of two different parts – the storage structure optimised for the production of the materials and storage structures optimised for the usage of the finished presentations.

PowerPoint or another presentation package

This conceptual study will use the simplest form of production tools for the creation of the overall structure of the presentation. The role of the presentation package is to create the slides in the presentation and to offer the producer of the slides a structure for documenting the spoken text for each slide. The developer of the presentation can use other presentation packages or applications for the same purpose.

QuickTime Pro for production

QuickTime Pro is used for production of the digitally based presentations, presentations that contain sound, pictures and eventually also animations and video. The developer uses QuickTime Pro to “glue” together the different parts of the presentation. There are several other tools to be used in the production of digitally based presentations but QuickTime Pro is the most used in these simpler contexts.

Server for the system

The server for the digitally based presentations is in this system a MacOS X Server running both an Apache web-server and a QuickTime Streaming Media Server. This allows for the presentations and lectures to be distributed both as ordinary QuickTime movies through HTTP and as streaming media. The last alternative does not allow for the user to store the material locally which can be an advantage under some circumstances.

QuickTime client for presentation

Each user in the system must have QuickTime installed. The choice of QuickTime is based on the support of the most used multimedia formats and the cross platform support. The ordinary users of the presentations do only need to install the functionality of the viewer and nothing

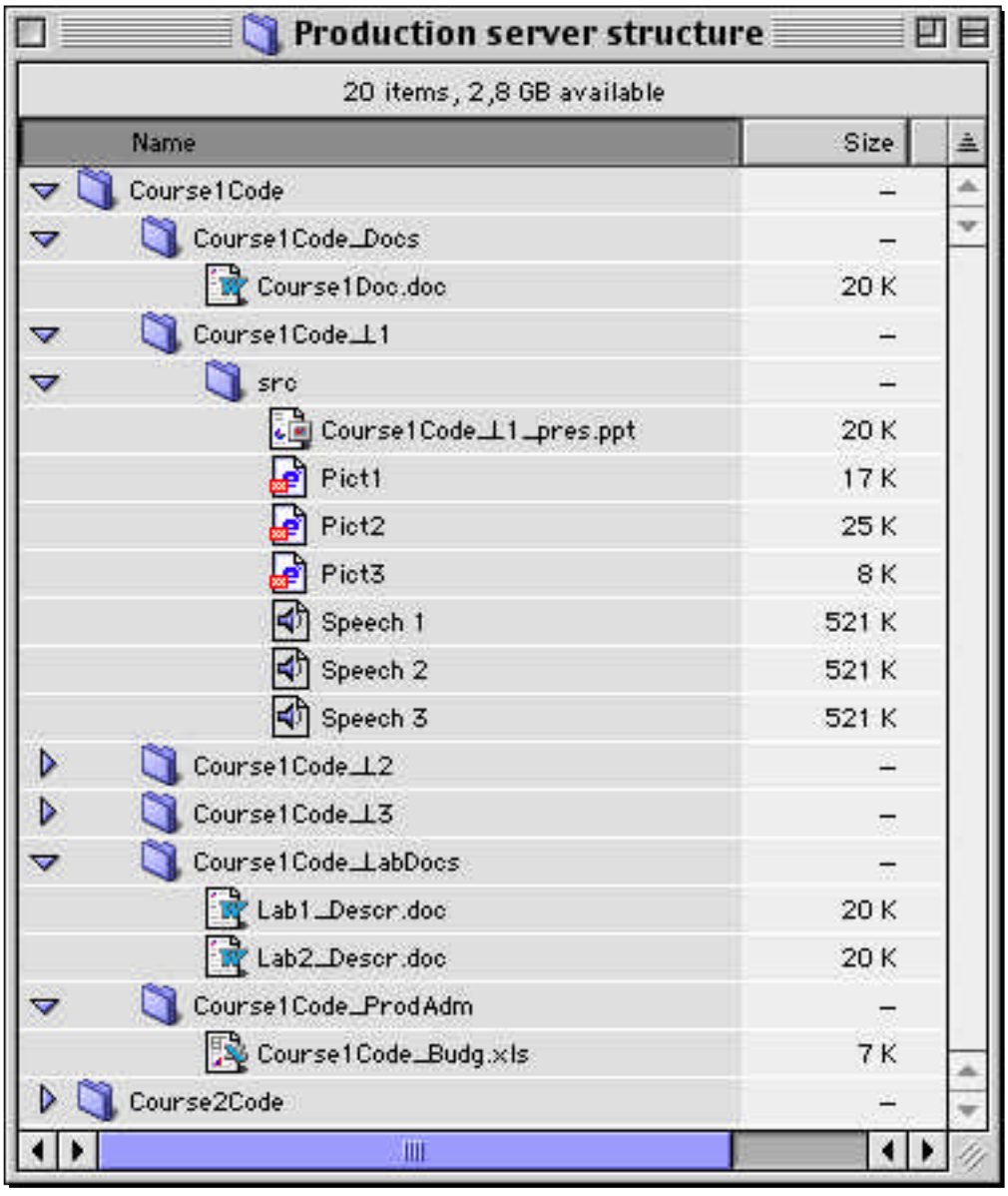
else. The presentations made by the techniques described in this document do not need the more powerful abilities of the Pro-version of QuickTime.

The storage infrastructure

As earlier mentioned the storage structure is important – both while developing the materials and when distributing the materials to the clients. The storage structure when developing the materials shall simplify both navigation and also re-use of materials across courses – a developer of a course material shall be able to easily find the source materials for important sections of another courses materials to use in his/hers own course.

Storage sections for the production

Below is an example of a possible storage structure. The text Course1Code represents the course-code used in your own organisation for a given course, the extension _L1 represents the presentation for digitally based presentation used in lesson 1, _L2 the presentation material for lesson 2 and so forth. The folder/directory called “src” is the storage place for the source of the presentation – sounds, pictures, animations, video and the presentation files acting as a framework for the development.



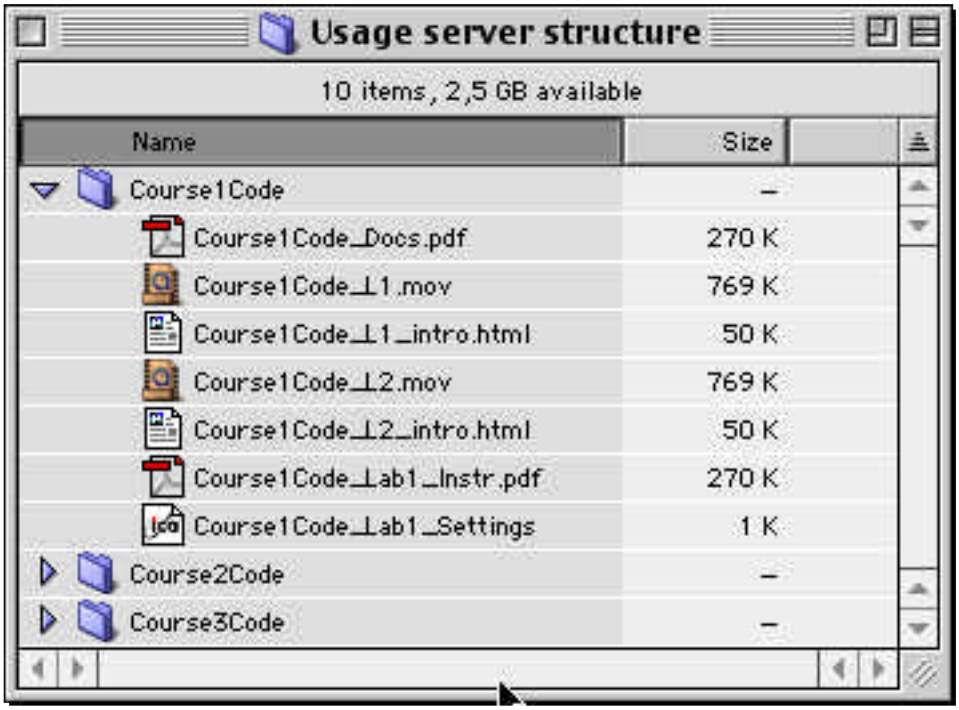
The root folder/directory of the Course1 also contain the folders described below:

- *Docs* function as storage for the documentation of the course that will be sent as PDF-files for the clients/students.
- *LabDocs* containing the laboration documentations and instructions.
- *ProdAdm* containing the administrative notes on the production of the learning materials.

This example of an storage structure allows for creators of other courses to “re-use” parts of any specific electronic course – its documentation, instructions and presentations. Organisations using this kind of storage structure together with others probably must evaluate strategies for co-operation and protection of the copyrights of the materials – will not be covered in this documentation.

Storage sections for the users

Below is presented a possible structure for the distribution server. Each course have their own folder/directory containing all the materials for the course – documentation, lectures, lab instructions etc.



In the illustration above are some samples of possible documents for a course:

_Docs.pdf is the course documentation that can be read from screen or printed out locally by the student.
_L.1.mov and *_L2.mov* are the electronical lectures that the student can participate through a web-browser or the QuickTime Player application.
L1intro.html and L2intro.html are the presentation pages for the lectures. These pages contain descriptional text for the lectures, presentations of the teachers and common information of the usage or the lecture materials based on QuickTime.
Lab1_Instr.pdf is the laboration instructions for the laboration 1 in the course.
Lab1_Settings is a settings file for connection to the central application servers containing the software for the laboration – CAD software or simulation software for example.

These files shall only be accessible to the students through the administrative system and the presentations can be separated into a separate structure optimised for streaming distribution – not covered in this documentation.

Steps in creating an Internet-based presentation

At large the steps in the creation of an electronic presentation are:

- Creation of the presentation
- Exporting the presentation as individual slides
- Printing the handouts for the presentation to be used as a manuscript when recording the speech.
- Recording the speech
- Assembling the presentation with QuickTime Pro
- Compression optimised for distribution
- Creation of the presentation page for the presentation.

Creation of the presentation

One advantage of using a presentation package like PowerPoint for creation of the structure of the lecture is that close to all the computers regardless of brands have that application installed. Some rules when creating an digitally based lesson:

- Assume that the user does not know how to use the presentation – the presentation should contain a first page containing information on navigation in the presentation and even references to an introduction.
- Respect copyrights and make room for a short presentation of both the teacher/teachers performing the lesson and some information on the content of the lesson.

During the presentation it is a good thing to make “pauses” – simple slides that are used to mark sections for laborations or tasks for the students to perform together with short descriptions on the location of the materials/documentation needed.

Some recommendations about design of the digitally based presentations:

- Do not use shades or gradients – these are difficult to compress in a good manner and gradients are dependent on the video abilities of the client to be presented well.
- Use colours sparingly and when using colours, use basic colours (red, green, blue). One cannot presume anything when it comes to the end users graphical abilities. And do limit the colour depth to 256 colours to limit the loss of information when exporting the presentation to individual slides.
- When creating slides containing formulas – save them as individual pictures and check how they look on screen. Several of the equation packages does not handle certain font sizes well – the resulting formulas are sometimes hard to read on screen and overhead presentations. The font sizes can be adjusted for better results. Save as GIF files before pre-viewing.
- Think modular! It is important for the students to be able to navigate in the lesson by choosing between sections in the lesson. Structure is important and will present the broad picture of the lesson before entering the details – this structure can later on be used to part the lesson into sections that the user can navigate between by a popup menu.

After the slides are produced the developer has to write down the text to be spoken at the display of the slide in the section assigned for handout comments. The text should be

structured in such a manner that the text easily can be co-ordinated with the bullets on the slides. Avoid at all costs to clog together all the text into one block – it is difficult for the person speaking the text to make the intonations at the right spots if all the text is given the same “weight”.

Exporting the presentation

For the best results the presentations slides should be exported as GIF files – they can easily be imported into QuickTime and if one uses only 256 colours in the slides they are also compact. A better format would be PNG but QuickTime does not import PowerPoint slides in that format.

The slides shall be exported and then stored in the src-folder/directory for the lesson on the server together with the presentation itself.

Printing the handout for the presentation

The handouts’ containing the spoken text is to be printed out before the recording of the speech takes place. One has to read through and test the text before recording it. It is a good idea to send out the materials for revisions and suggestions before making the recordings. It is also good to choose a person with a good voice for the recording – nothing is more dulling than listening to a monotone voice describing advanced curriculum.

Recording the speech

Depending on the computing platform the developer can choose different tools for the recording of the speech in the lesson. Since there are so many versions and kinds of software for the recording of sound we have to refer to the specific software’s documentation for recording of sound. The format of the recorded sound must be of the type WAV for PCs and AIFF/system sounds for the Macintosh. Some recommendations:

- Use a good microphone. A good choice is a Jabra EarPhone, a combined microphone and earphone that avoids the “huffing and puffing-effect” that easily occurs when using ordinary microphones. Another good choice are microphones designed for voice recognition.
- Record the sound with optimal settings for sampling. Do not “over-sample” since it will make the recordings large and make them difficult to handle in the rest of the production process. 22 kHz is a good value – humans cannot hear higher frequencies anyway.
- Do not be afraid to re-record a spoken text. Remember that the students need to clearly hear the speech using same frequencies as over a mobile phone in the worst scenarios.

The sounds shall be stored in the same src-folder/directory as the slides for the lesson. Be careful to check the available storage space for the materials – the sound files are the most spacious of the files needed to create a lesson. The free space must be at least several hundred megabytes and that free space is also needed in the computer on which the sound is recorded.

Assembling the presentation with QuickTime Pro

The main steps in the production of the digital lesson will be as follows:

- Import and place the sound for the slide at the appropriate place.
- Copy the slide and paste it into the digital lesson as a scaled graphic – shown while the sound is playing.

The resulting movie is only a placeholder for the different files building up the lesson. This movie contains information about where and under what circumstances the different files are to be played. To allow this movie to be distributed it has to be exported/saved as a separate movie that shall be stored in the distribution storage structure for the lesson.

The production steps in detail:

Open QuickTime Player. By this step an empty window is presented. This window represents an empty movie not yet saved to disk.

The window contains a meter used to navigate in the movie – two endpoint markers and a position marker these markers are important in the production process. The endpoint markers marks the beginning and end of a selection in the movie and are used by the developer.

The first step is to save the presentation into the src-folder/directory giving it a name that corresponds to the lesson and course. For this example we will name it HydraulBasics_L1_src.mov – first lesson in the course HydraulBasics (Basic hydraulics). The code _src.mov is the code for a source-movie, a movie that is used in the production process and not for distribution.

After this step the window looks like this:

The next step is to open the first sound-file containing the speech for the first slide. Open the sound-file for the first slide (they should be placed in the source-folder for the lesson - src).

This window contains the sound but before we can copy it into the lesson, we have to issue the command “Select all” from the Edit-menu. By this the whole sound-file is chosen and after that we can give the command “Copy” from the Edit menu to copy the sound in the file. Below is presented how the window looks like after issuing the “Select all”-command.

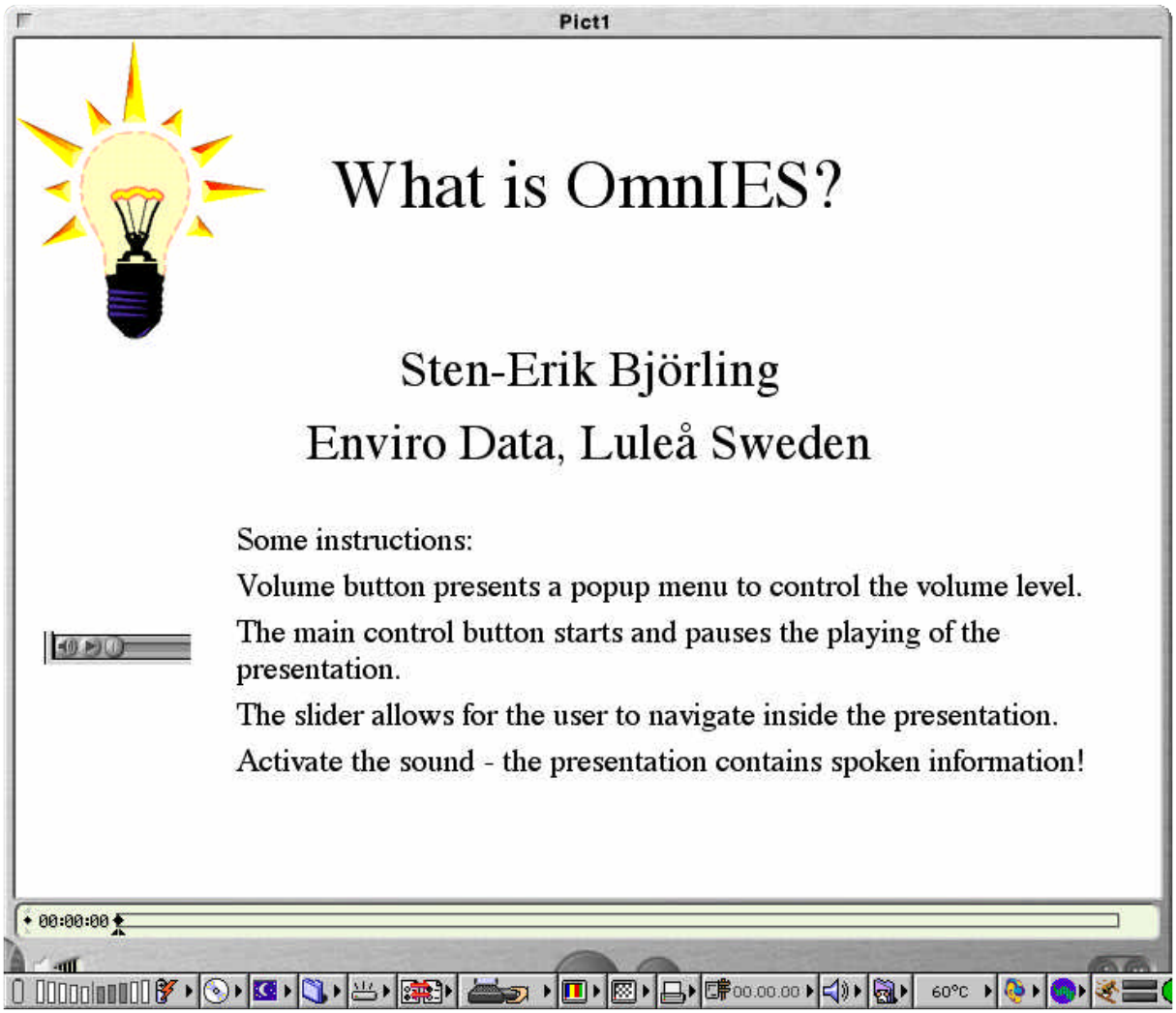
In this window, we can see that the selection markers are placed at either end of the content of the sound-file and that the position marker is placed at the beginning.

Now select the window representing the lesson and give the command “Add” from the Edit-menu by holding down the alt-key while pulling down the menu. The “Add”-command inserts the copied sound at the end of the current content of the lesson movie. The lesson movie window should look like the presentation below after the operation:

Note that the position marker are now placed at the end of the sound we pasted. The most common mistake is not to place the position marker at the beginning of the selection before inserting the graphics presented during the speech. Move the presentation marker to the position of the first selection marker representing the beginning of the selection. By this the window should look like below:

The position marker tells us where the selection we paste into the presentation will be entered – if we do not do this right the sound and the picture will not be synced.

Now is the time to paste in the graphics for the slide – open the slide representing the speech from the src-folder/directory.



Copy the content of the slide by issuing “Select all” and “Copy” from the Edit-menu. Activate the lessons movie-window. Now a check before you go any further:

Is the position marker placed at the beginning of the selection representing the sound/speech? If not place it there.

The picture shall be presented while the whole sound representing the speech is playing. To do this we must paste the graphics in a “scaled” form so it will be shown during the time between the selection markers representing the speech duration. The command for pasting a graphic in scaled mode is performed by holding down the alt- and shift-keys and giving the command “Add scaled” from the Edit menu. If you do wrong you can undo the command or close the movie without saving and reopen the last saved version. Do not save until you are happy with the additions to the lesson movie.

Test the result before going further.

Next step will be repeated for each slide in the lesson. Brief overview:

- Put the position marker at the end of the movie.
- Open the sound-file, select all and copy.
- Activate the lesson movie and issue the command “Add” by holding down the alt-key while choosing the “Add” command from the Edit-menu.
- Move the position marker to the first selection marker representing the beginning of the added sound.
- Open the slide graphics for the sound containing the spoken text.
- Select and copy the slide by the command “Select all” and “Copy” from the Edit menu.
- Choose the lesson movie and check that the position marker is at the beginning of the selection representing the sound.
- Issue the command “Add scaled” by holding down the alt- and shift-keys from the Edit menu.
- If you are pleased with the result – save the lesson movie and close the windows representing the sound and graphics for the slide. Otherwise the desktop will be cluttered after a while.

Compression for distribution

As earlier mentioned the produced movie is not to be used for distribution. First of all the content of the lesson movie has to be integrated into one file and secondly it have to be compressed. Lesson movies in production can occupy several hundred megabytes and that is not suitable to send to the clients in the network. To make the material suitable for distribution it has to be compressed. In several instances it is a good idea to compress the same lesson movie for different distribution media and speeds but that will not be covered in this handbook.

Compression is done on both the sound/speech and on the graphics/video in the movie by two different setups of compressors. The compression takes place while exporting the source movie for the lesson to a distribution version placed into the distribution server.

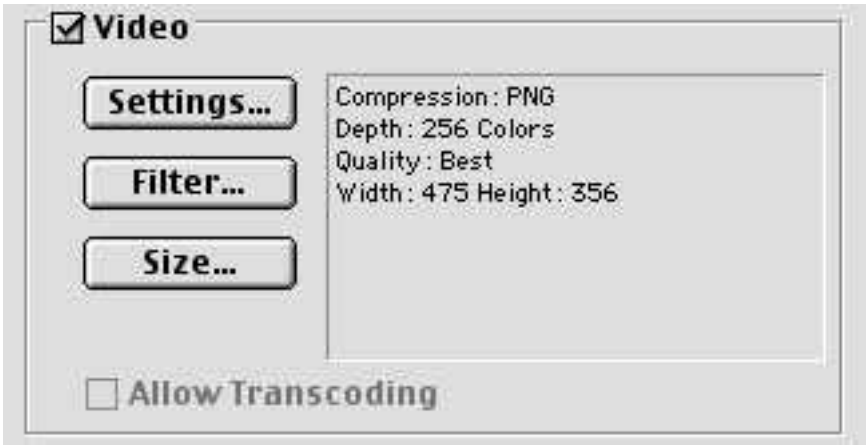
The export and distribution of the movie is done as follows:

- While the lesson source movie is open and active choose the command “Export…” from the File menu.
- Navigate to the correct directory/folder where the movie shall be stored.
- Name the movie according to the naming rules in your organisation for this type of movies.

· Press the button Options.

You are now placed in the mode to define the compressors types and settings. There are two main groups of compressors – video/graphics and sound. The settings presented in this handbook represents optimal settings for lessons containing simpler slides and sound quality representing good phone lines. These settings are optimised for distribution of the lesson with modems, not LAN-based communications.

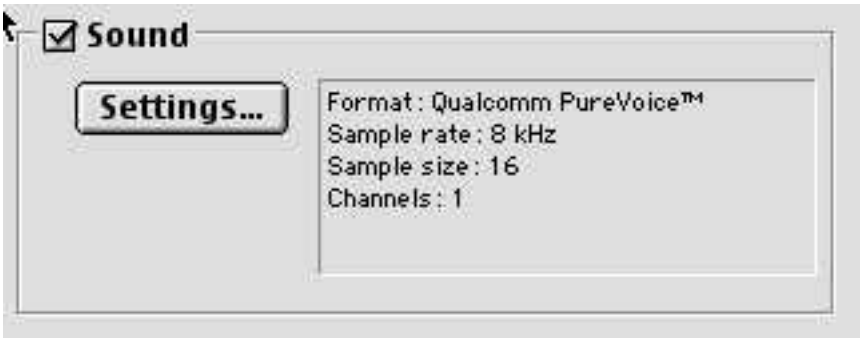
The settings for the video/graphics:



Since we exported the graphics from PowerPoint in 256 colours it is not optimal to choose a higher setting for the PNG format. PNG is chosen because the GIF format is presently under conflict and licensing costs could occur at a later stage if it is used. PNG is a good replacement format. Sizing the graphics to a smaller size compresses the lesson movie even more but then one has to test how the scaled graphics is presented at the client – the text can easily become unreadable.

These settings are optimised for simple graphics – if video is used in parts of the lesson other settings has to be evaluated and the distribution methods has to be re-evaluated. Video is extremely demanding when it comes to bandwidth and its use must be scrutinised thoroughly before implemented over the Internet.

The settings for the sound/speech:



PureVoice is a compressor specialised in compression of speech. The settings presented are really compressing the speech and will represent the quality of speech when talking over a telephone. This setting together with specialised settings for streaming gives extreme

compression – a lesson with this setting and large graphics demands no more than 100 kBytes/second in transfer rate which can be handled even by a 28.8 modem connection.

The settings for the sound can be modified for different distribution speeds – the better quality requested the higher the demands on the bandwidth. It is a good idea to make a version for lessons held in groups with loudspeaker equipment with better quality if the needed bandwidth exists.

Some final thoughts and complementary information.

This handbook covers the production of the most simplest forms of digital lessons. There are much more developed tools in the market that can be used to produce even more advanced contents and higher functionality. This handbook is an entry-point for those who wants to get started with production of digital lessons and for this purpose QuickTime Pros basic tools are adequate.

During the initial testing of digital lessons produced by this simple method a number of thoughts has popped up – usage of animations, pointers, embedded smaller video sequences etc. All these suggestions will be evaluated further but demands more advanced tools and production methods and cannot be covered by present budget or schedule.

Appendix B: Installation manual IEA Annex V website.

This short description will guide you as a user of the IEA Annex V website in the installation of products that are mandatory to be able to use the site. The manual will also cover the initial registration phase for the WebX conferencing system used at the site. All the links for the installations are placed in the section of the site named “Vital Info”.

The manual is divided into the following sections describing the installations/registering of:

- Apple QuickTime
- Adobe Acrobat Reader
- Omnis Software’s Omnis Thin Client
- User registration for the WebX conferencing system

This manual does also contain advice and tips for system administrators for making the installations easier and faster using customised CD-ROM disks.

Apple QuickTime

Apple QuickTime is responsible for close to all the handling of multimedia on the site – movies, sounds, pictures and the digital lectures presented in the usage of the OmnIES system. A link to the presentation/registration screen for QuickTime is placed in the section Vital Info. A basic download of QuickTime is free.

The installation steps are as follows:

- Go to Vital info -> Components section. Click on the link Apple Computer QuickTime.
- Click on the graphics “Download the player”.
- Fill in the registration information.
- Make a choice of operating system.
- Press the button “Download”.

The file that is downloaded is a small application to handle the real installation of QuickTime. Place this installation app in a directory in the hard-drive and run the application once the download is finished.

The installation application will guide the user in installing the QuickTime environment. The recommended choice of installed components is the basic install. After the user has made the choice of installed modules the installer will fetch the components from a server across the Internet. The computer is recommended to be restarted before any QuickTime content is played for the first time.

During the installation the user will be asked to inform the installer if QuickTime shall handle Windows-based media formats. This is not needed for the formats used in the IEA Annex V site but can be an advantage in other circumstances.

Important!

One problem that the user can encounter is a “format-war” between the QuickTime and Windows Media Player/RealVideo. When upgrading the Windows Media Player or RealPlayer they just takes control of the assignment that the user has done which player is assigned the role of playing multimedia formats. Microsoft Media Player simply disregards the assignments made by the user. A simple countermeasure is to re-install the QuickTime player again from the installer. After the installation is done the first time the QuickTime installer does not need access to the net to perform the update.

Adobe Acrobat Reader

Adobe Acrobat Reader is responsible for handling of the PDF-documents used at the site and in the OmnIES conceptual application. A link to the presentation/registration screen for Acrobat Reader is placed in the section Vital Info. A basic download of Acrobat Reader is free.

The installation steps are as follows:

- Go to Vital info -> Components section. Click on the link Adobe Acrobat Reader.
- Fill in the registration information and choices for operating system etc.
- Press the button “Download”.

The file that is downloaded is a complete installer of the Acrobat Reader application and plug-in for reading PDF-documents from within a browser. Run the installer and follow the instructions on-screen.

Omnis Software’s Omnis Web Client

Omnis Software’s Web Client is responsible for handling of the OmnIES conceptual application. A link to the presentation/registration screen for Omnis Software Omnis Thin Client is placed in the section Vital Info. The download of the Omnis Thin Client is free.

The installation steps are as follows:

1. Go to Vital info -> Components section. Click on the link Omnis Studio Thin Client.
2. Fill in the registration information and choices for operating system etc.
3. Press the button “Download”.

The file that is downloaded is a complete installer for the combination of browser and operating system. If the user uses different browsers and/or operating systems several installation files must be downloaded and run. The installation is not recommended to be performed while the browser is active – the browser will not recognise the plug-in until restarted.

During the first use of an application using the Omnis Thin Client it will check if the installation contains all the elements needed to use the application. The OmnIES system uses

a tab-bar component that needs to be downloaded into the client and that is done automatically after informing the user. The OmnIES system does also update itself automatically after the first install – no need to re-install with new versions.

User registration for the WebX conferencing system

The IEA Annex V site contains a discussion section that is handled by a system named WebX. The discussion section allows for participants to exchange information covering the areas that are presented in the site. In this section the status reports and planning for the site are also presented.

To use this section in the best way demands that that the users registers themselves before making entries in the different forums that constitutes the discussion section of the site. The reasons for this are:

- By knowing who is asking the contributors can create better answers.
- By knowing the background of the individual the members in the forums can identify contributors with the same background and can quicker start up new specialised forums.

The registration process is simple.

1. Click on the link “Discussion” in the main menu.
2. In the top line that describes the current status of the user – click the link “Register”.
3. Fill in the form and press the button “Register”
4. Press the button “Preferences” to customise the handling of messages. The important part here is the personal description and the email address. The user can also insert a personal picture.
5. Click “Set preferences” and then the OK-button to return to the main screen logged in as the customised user.

Important!

The discussion area at the Annex V web-site contains a small tutorial for using the WebX conferencing system. The title of this tutorial is “A guided tour of Web Crossing”.

Tips for system administrators

Both users and system administrators can download all the components and store them on network drives and/or internally produced CD-ROMs. The installers for Adobe Acrobat Reader and the Omnis Thin Client are complete installers and can be stored at these locations as is - QuickTime is different matter.

When the QuickTime Installer has been run for the first time a file called QuickTime Install Cache is placed in the same folder/directory as the installer. Most of the time a file called QuickTime Updater is also placed in the same folder, handling the updates across the Internet of the QuickTime environment. These files are used in all the subsequent installs of the QuickTime environment and allow for the install to take place without network connection.

Thus all these files must be present in an installation package on CD-ROM or in network drives used for installation.

Note that the installations of Omnis Thin Client updates and modifies itself after the first install – new versions and/or new components are automatically installed.

The installation package is also recommended to contain the Windows-based fonts Times New Roman and Arial for the Macintosh for those users that do not have Office for Macintosh installed. This allows for creation of really compact PDF-documents for all platforms since the fonts do not need to be included into the documents.