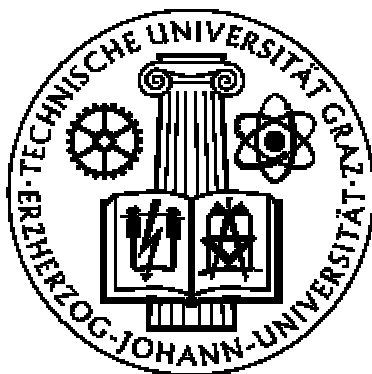# Design And Implementation Of A
Course Generator For A
Web Based Training System

Diploma Thesis in Telematics

1998

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Institute For Information Processing and
Computer Supported New Media
http://www.iicm.edu

Ich versichere, diese Arbeit selbstständig verfaßt, andere als die angegebenen Quellen und Hilfsmittel nicht benutzt und mich auch sonst keiner unerlaubten Hilfsmittel bedient zu haben.

Die Arbeit ist in englischer Sprache verfaßt.

Michael Gartler
Graz, im August 1998

Kurzfassung

Design und Implementierung eines Authoring Tools zur Erzeugung neuer Kursdatenstrukturen für ein netzwerkbasierendes Lernsystem

Eine der Hauptanwendungen im Intra- bzw. Internetbereich sind multimediale Lernsysteme zur Mitarbeiter Aus- und Weiterbildung. Web Based Training (WBT) nutzt moderne Informationstechnologie und Hochleistungsdatennetze um Wissen und Lerninhalte in multimedialem Format flexibel und kosteneffizient direkt an den Arbeitsplatz des Benutzers zu transportieren. Die Arbeit erläutert sämtliche Aspekte von WBT und geht auf bestehende Systeme und Forschungsergebnisse ein. Im Mittelpunkt steht die Anwendung von Hyperwave als WBT Plattform, wobei der WBT-Prototyp GENTLE (GEneral Network Training and Learning Environment) und das Einsatzgebiet im Datennetz der TU-Graz detailiert beschrieben werden. Die umfangreiche Darstellung eines Authoring Tools zur unkomplizierten Erstellung von Kursstrukturen (GENTLE Modul 'Course Wizard') geben Einblick in eine typische Intranet Applikation, in der Client-Side JavaScript, Perl-CGI, HTML und Hyperwave-spezifische Programmiertechniken (PLACE) zum Einsatz kommen.

Abstract

Design And Implementation Of A Course Wizard For A Web Based Training System

One of the major Intra- / Internet applications are multimedia content learning systems suitable for employee training. Web Based Training (WBT) utilizes modern information technology and broadband data networks in order to transfer knowledge and courses ('Courseware') in various multimedia formats directly to the employee's working place (on-the-job-training). This thesis illustrates all aspects of WBT and describes existing systems and results in academic research. The main focus is set on Hyperwave as proper WBT platform, hence the WBT-prototype GENTLE (GEneral Network Training and Learning Environment) and its application in the TU-Graz broadband university data network are described in a very detailed way. Furthermore, there is an extensive presentation of an authoring tool used to easily create an empty courseware data structure on the WBT server (GENTLE module 'Course Wizard'). The implementation of the Course Wizard with client-side JavaScript, Perl-CGI, HTML and Hyperwave specific programming techniques (PLACE) gives an insight to the mechanisms of a typical Intranet application.

Contents

Preface

The main area of this work is concerned with Computer Aided Learning (CAL) and Web Based Training systems (WBT), applications suited especially for so-called 'Intranet'-environments. It is a new sophisticated form of teaching, using the capabilities of modern computer networks. Students and their teachers are no longer together in a classroom at a given time: with WBT students can decide when and where (mostly at home or in a student-hostel, using a personal computer and a proper network connection) they attend a course lesson. Working for the GENTLE-project (General Networked Teaching and Learning Environments introduced by Hermann Maurer; it is one of various projects of the Austrian Web Application Center, AWAC) led by Thomas Dietinger at the Institute for Information processing and Computer supported New Media (IICM: http://www.iicm.edu, Graz University of Technology, http://www.tu-graz.ac.at) my task consisted in conceiving and designing the basic structures for the GENTLE WBT course environment and in implementing a proper authoring-tool ('The GENTLE Course Wizard') for the web teacher to build the courseware 'skeleton', the basic data structure needed for a course on the Hyperwave education server. The GENTLE-WBT system (see our GENTLE Course Server at http://wbt.iicm.edu) will be used in winter semester 1997/98 for teaching the course Multimedia Information Systems in order to gather first results. This implementation of a WBT-system can be seen as a special application of the powerful Hyperwave server environment, also developed by a programming team at the IICM (headed by Professor Maurer), now forming a commercial enterprise called 'Hyperwave' (http://www.hyperwave.com). Nevertheless, there is also a chapter with further aspects of Intranet-Technology, Computer Supported Collaborative Work (CSCW) and computer network communication applications, like teleconferencing, teleworking, virtual companies and electronic commerce, application sharing etc. Due to the permanent increase of computation power and data bandwidth this sort of communication will gain more and more importance in modern day business and private life.

Acknowledgements

First of all, I would like to thank Thomas Dietinger for his help and support during my writing of this diploma thesis. He always took enough time for my questions though in his position as an university assistant and AWAC project manager his time schedule is very busy. In case there was no time for personal meetings, modern information technology came into application: When I finished a chapter of my diploma thesis, I sent it via e-mail to Thomas. He read and commented my chapters and sent it back to my working place, which was sometimes at my office room at the IICM and sometimes at my private home (I have accessed the Internet by using a modem). This turned out to be a very effective working mode.

Furthermore, I would like to express my thanks to the following persons: Angela Grim, Christian Fessl, Mattias Moser and Richard Persché who gave me a lot of tips and tricks in JavaScript, Perl-CGI and PLACETemplate Hyperwave server programming. My thanks go also to Elke Woldrich (who helped polish my English) and my parents for their 'mental' support of my work.

In general, the working conditions and climate here at the IICM are very favourable which is from my point of view a vital element for efficient software solutions of good quality.

In order to finish my acknowledgements, I hope that this diploma thesis will give a comprehensive overview of Web Based Training Systems and some aspects of Intranets and Computer Supported Collaborative Work.

Please enjoy reading. If you have any comments concerning it, please contact me by sending an e-mail to mgartler@iicm.edu ! Best Regards,

Michael Gartler
Graz, Austria, August 1998

1 Introduction

Teaching and learning are very important activities in our lives. Starting in primary school, we have to collect knowledge and information throughout our whole life. The question is not why we should learn, but how we should learn. All of us are familiar with the 'traditional' ways of education - like in schools or universities. Students have to go to a classroom or a lecture hall in order to listen to the teacher's lecture at a fixed time and date (the courses are arranged in a static teaching schedule). Often there is no conversation or dialogue between students and teachers at all.

What are the problems in this 'classic' teaching scenario ?

- First of all, students need much more freedom and individuality when and where they attend a course lesson or lecture (this feature can not be provided with traditional teaching methods).

- Secondly, students need conversation and discussion with the teacher when something is not correctly understood (this features can not be provided well enough on a big number of students with traditional teaching methods).

- Furthermore, discussions among all course participants should be at their disposal to solve most of the problems. (this feature can not be provided with traditional teaching methods).

Thus, when traditional teaching methods fail in such important aspects, what can be done better then ?

Unless you have been living in a cave for the last 5 to 10 years, you will perhaps know, that computer and communication systems have virtually reduced mother earth to a global 'cyber' village populated by 'cybernauts', hackers, virtual companies, various computer freaks playing Doom or Duke3D (for all who are interested: See http://www.3drealms.com) over the net and serious virtual communities like we as university folks. Technology developed gigantic means to handle large amounts of what-so-ever data (for example , say text, pictures, audio, even video clips - the whole stuff is called 'MultiMedia') and to communicate with people all around the (more civilised) world. Like in Alaska and Canada a hundred years ago, there is a gigantic gold-rush going on in areas concerned with the Internet and telecommunication systems like cellular phones (Picture: Nokia 9000 Communicator. Combination of PDA and cellular phone)

Back to education and teaching. Here is a first approach how information technology can be used to answer the questions above:

- As mentioned, students need more freedom and individuality in the way how and when they attend a course lecture. The same course content students are listening to in a classroom, in training centres or lecture halls can be transferred to their preferred learning place, for example to their private home, student hostels or any place when mobile computers are used together with cellular phones and modems (Notebooks or Personal Digital Assistants - PDAs, e.g. the Apple Message Pad 2100, see picture to your right). This can be done via a computer network and a central education server, the data bandwidth needed is no more the problem. The students can access the education server any day at any time - hence it seems that the first problem is solved (theoretically, there are still a lot of problems around, which will be mentioned later in this text).

- By means of the computer network, students can always communicate with their teachers. Of course, the teacher does not always sit behind a workstation, 'chatting' all the time with students. E.g. the teacher is out for lunch, students can send their questions and annoyances to him via an electronic mail system. Like using a voice mail machine, all messages are stored at the teacher's account on the course system and after having lunch the course teacher can go back to office and reply to all the student's complaints. Options can be set, so that parts of a discussion between one student and the teacher become visible to all other students, when relevant things are involved in the dialogue. Student-to-student (perhaps even teacher to teacher discussion ?) conversation and discussion can be accomplished like teacher-student conversation.

Theoretically it is true that this approach represents an easy step from traditional lecturing to a learning and teaching scheme explained above using information technology ('Web Based Training', just to name one conception). At least there could be a good combination of the two methods. As we all know, it's the little things that cause the problems. A lot of engineers and computer scientists from various universities all around the world have tried hard to introduce computer and information technology in teaching and education, until now none of them were quite successful at a grand scale.

There have been many attempts to use computers for educational purposes. The expectations in such systems were very high, but intensive research and development in the area of Computer Aided Instruction (CAI) only revealed uncountable pitfalls.

First systems did suffer from the lack of sophisticated hardware components needed to create and present high quality course modules, e.g. high resolution colour images, audio and video clips. As technology moved forward, hardware became cheaper and cheaper although the performance raised steadily.

Web Based Training Systems

Many advantages over the so called „traditional" classroom courses are offered by Web based education systems. The participants of a web based course do not have to be physically present, they attend classes and lectures via the computer network. Hence, much more students can be reached.

A very individual learning environment can be established by means of adaptive courses, which dynamically adjust the contents and the appearance in order to satisfy the student's

learning habits and knowledge. Otherwise, this can only be found in a single - teacher / single - student relationship.

To prevent isolation, various communication facilities are provided by the training system. This ranges from simple email to sophisticated audio and video connections, even multi-participant conferences are possible. Communication is among other things the key for the success of web based training, because isolation often leads to helplessness if some problems arise or some fact is not correctly understood ('Tunnel Syndrome[1]').

Note: The intention lies not in the fact that the human teacher will ever be completely replaced by a computer based learning environment. Nevertheless, computers and information systems can be a good complement to the teacher's activities and there are many unique parts to play in modern education.

Courseware problems

'A very common belief is that no one teaches but everyone learns.' [🖥 Lopes 1996]
This sentence is quite true. Traditional lecture or Web Based Training, it doesn't matter, is bad when the teacher and/or the teaching material (the 'Courseware') is/are bad, anyway. At university there are lots of examples of poor teaching (various negative experiences as a student at the Graz University of Technology, though this might be very subjective).

Many Courseware packages break even the most fundamental rules of good design:

- 'Too much text cluttering the windows'
  Worst case here: page after page copied straight from books!
- 'Cluttered diagrams'
- 'Flagrant abuse of colour combinations'
- 'Too little or too much flexibility in navigation paths through the material'
- 'Inappropriate or patronising computer generated responses'
[🖥 Lennon 1997b,10.2.2]

Second, Courseware material can expire quickly, particularly in the amazing fast changing world of information technology. For example, within the area of the Internet nine months are a really long period of time and according to Moore's Law[2] computation and information storage performance doubles in the same time, just to see how time is measured within the information age.

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[1] CBT students often suffer from a 'tunnel syndrome' because they are restricted to material stored on the CD-ROM and they do not have the possibility to get an answer to a question which is not foreseen within the course system.

[2] Moore's Law: The observation that the logic of silicon integrated circuits has closely followed this function: bits per square inch = $2^{(n-1962)}$. The amount of information storable in one square inch of silicon has roughly doubled yearly every year since the technology was invented.
http://nmsmn.com/~cservin/jargon/m/mooreslaw.html

Third, miscellaneous other problems and pitfalls have to be avoided:

- Replacing the 'tunnel effect' and 'page turning' by arbitrarily free navigation leads often to 'getting lost in hyper-space' and disorientation.
- Images, Video and Audio clips increase the amount of data. Only broadband data networks can come along with such multimedia applications.
- Preparation of small packages is easy. On the other hand, those never having considered pedagogical or design issues suddenly believe to be courseware designers resulting in bad courseware.
- It is not enough to prepare small courseware packages. Large databases of modules (repositories), and re-usable, easily maintainable and customisable modules are necessary.
- Courseware should be available both in stand-alone and networked mode.

Summary

As a summary and conclusion to all of this, I think that the following lines by Hermann Maurer have to be put into our consideration, too: 'Let's start an integrated approach in CAI !'

'*CAI* (Computer Aided Instruction), *CBT* (Computer Based Training), *ITS* (Intelligent Tutoring Systems), *WBT* (Web Based Training) and similar efforts that have tried to support teaching and learning through (networked) computers have generally failed and will continue to do so, unless an integrated approach is taken, i.e. unless all necessary ingredients are taken care of.' [⌨ Maurer 1997,1]

I am an engineer of Telematics, so one might ask which role Telematic plays in the field of Web Based Training. First, let me explain what 'Telematic' in the sense of the Graz University of Technology means: 'Telematic' engineering is a combination of two large areas of research, it builds a bridge between them: Telecommunication technology and Informatic. The first one takes care of all the data transmission and signal processing (here you can find the more hardware based scientific areas like electronics and electrical engineering), the second part provides the correct data processing with sophisticated mathematical algorithms. Hence, this is a very powerful mixture. (Since 1985 students can study Telematics at the Graz University of Technology in Austria. There is also a Telematics Engineers Society ('Telematik Ingenieurs Verband', TIV) in Austria. See more information about it at http://www.icg.tu-graz.ac.at/tiv)

With the sophisticated networking technologies available nowadays, the door opens wide for an integrated and straight-forward approach to implement huge and wide-spread hypermedia databases or libraries and hence facilitates the implementation of computer/web based learning and virtual co-operation scenarios. So, in my opinion, it is up to the engineers of Telematics to take this above mentioned integrated approach in CAI, '..not because it is easy but because it is hard!' (borrowed from a speech by John F. Kennedy, America's famous president of the early sixties. It was mentioned there in an other context, though[3])

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[3] '[...] We choose to go to the moon. We choose to go to the moon in this decade and do the other things, *not because they are easy, but because they are hard*, because that goal will serve to organise and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too.[...]' (John F.Kennedy, Address at the Rice University on the Nation's Space Effort. Houston, Texas, September 12, 1962.
See http://www.cs.umb.edu/jfklibrary/j091262.htm)

2 New Modes Of Learning

This section describes modern learning scenarios and environments at companies and universities. Today, students and other learners often have a full-time job when they are pursuing professional and personal development. Thus, working and learning are no longer mutually exclusive activities. Furthermore, we have the need for continuing education and training ('life-long learning') because of the rapid technological change. New or re-assigned employees need introductory training, too. Estimates have suggested that we are entering a period when the training that workers receive will become obsolete within three to five years. In the last years cost of technology has prohibited widespread use of distance learning methods, but recent reductions in the cost of hardware and software have lowered that barrier.

Why 'Life-Long' Learning ?

As mentioned before, there is a growing need for continuing, life-long learning in our society.

The following questions raise:
- Why do we need 'life-long' learning ?
- Why is it so important ?

(Possible) answers are : Because...

- ...There is a *rapid technological change.*

- ...Training and education is an *ongoing necessity in business.*

- ...Workers have to *remain current with required skills and knowledge.*

- ...People *change their careers and jobs more frequently*, six to seven changes as average

- ...Increasing the skill and knowledge means to *increase someone's marketability*

2.1.1 Advanced Learning Methods

Classroom-Based Training

The traditional way of learning and training is class-room based and instructor-led (LBT - Lecture Based Training). All students and their teachers have to be in the same room at the same time. Thus, there are significant time and place constraints in this learning scenario and individual treatment for each student can not be guaranteed. Some characteristics of this learning environment are listed below:

- 'Face-To-Face' communication between teacher and student
- Social contact with fellow students
- Learning at a fixed place and time
- Individual treatment for each student not always possible
- Courses are not customised to different learning styles

The traditional way of learning becomes more and more obsolete in present learning scenarios, for example, the logistics of attending classroom education are increasingly difficult to manage.

Often people need to take a course but must wait until instructors or facilities can be scheduled or until enough students sign up to justify its expense. In general, a waiting list of prospective trainees has to be maintained until there are enough people to fill a course. Arrangements for these students, the instructor, facilities and courseware material have to be made, this is not an easy task: they must all be available at the same time and place.

Technology-Based Training

Advanced learning scenarios take advantage of modern communication systems and information technology. The basic idea is to deliver training or courses directly to the learner's working place or home. The learning environment should be individual for each person and depending on the learning objectives. What the traditional way of lecturing is concerned, in a classroom everyone got the same 'type' of instruction, there were no means of 'adaption' to the learner. Computer and network based learning environments offer the possibility of so-called 'adaptive courses', which are intended to fit best everyone's learning styles and habits. For example, a percentage of students learns best with visual course material, others learn better with abstract text descriptions. All these issues will be described and discussed in this section.

Advanced learning environments – a first summary:

- Individual learning environment possible

- Self-paced learning becomes possible

- Cost-effective learning because students can work at home or at their working places

2.2 Terminology

First, we must define some important terms and objectives needed to create a sophisticated learning environment. Distance Learning and Distributed Learning are the basic ideas applied in all Web Based Training systems providing a flexible and individual learning system unknown so far.

2.2.1 Distance Learning

Definition: Distance Learning is characterised by the fact that the student (learner) does not have to be present in a classroom (a given location) in order to participate in the instruction. Time and place parameters of an instruction can be variable. There is no face-to-face environment. Distance learning can be a good method to transfer and learn new knowledge and information, the student is a passive learner.

Techniques for Distance learning include broadcast TV, audiotape and videotape, it is a one-to-many communication.

Example: Several European, Canadian and Australian schools offer courses via TV broadcast. In the United States the Public Broadcast System (PBS) has some 350.000 subscribers to it's open university. Students have to receive the instruction at some specific time but there are no place constraints.

2.2.2 Distributed Learning

Definition: **Distributed Learning** is Distance Learning enabled by modern telecommunication technology and focused on collaborative, learning-team based education. It is facilitated by a content expert and delivered anytime and anywhere.

Distributed Learning goes far beyond the concept of Distance Learning: Modern computer networks are used to enable collaboration and communication between all participants of a course. As an example, there are already 75 accredited universities in the United States which offer online degrees.

2.2.3 Learning Objectives

Definition: A **Learning Objective** is defined as the desired outcome of education.

Three major learning objectives can be classified, which should be taken into consideration when designing a course or a curriculum.

Classification of Learning Objectives

1. **Information Transfer**

   First, the student has to acquire and memorise new information. Students learn new facts, they do not have to interpret or change it. Information transfer enhances a person's knowledge. Information transfer is often done with traditional learning methods, where the teachers are experts on their fields and have full control of the learning material and learning pace. The teachers 'transmit' their knowledge to the student. Information transfer can also be accomplished with a Computer Based Training system (CBT), with knowledge and information stored on a CD-ROM, for example.

2. **Skill Acquisition**

   The second stage is skill acquisition. When a student had enough information transfer (theoretical knowledge on a subject), it is time to apply this knowledge to create new knowledge and to get experience. At this level, the student has to interpret learned information and facts in order to solve real-world problems. Skill acquisition can not be done as easy as Information transfer, many questions and problem will arise on the learning path. Thus, students must be coached and assisted by their teacher. CBT systems will be mostly insufficient for skill acquisition due to the lack of a communication facility. Using CBT systems, students will only interact with the learning application executed by the learner's workstation. Web Based Training systems can be the proper solution for skill acquisition because discussion forums and other communication facilities are used for coaching the student.

3. **Team-Learning Experience**

   Finally, students must learn how to integrate their knowledge and skills within a group of other learners to commonly create new knowledge. Students work together on a problem and the role of the teacher is to facilitate maximum sharing of information among the individuals rather than controlling the delivery and pace of the content. Direct feedback to the students and an environment for peer feedback are needed in this scenario. The ability to work in groups is very important, the students should see that team learning is the most effective approach in problem solving or research-oriented areas. Team-Learning experience can be achieved with traditional methods or by using Web Based Training systems that supply sophisticated, Computer Supported Collaborative Working (CSCW) applications, like teleconferencing, discussion forums, application sharing or whiteboards. CSCW based learning models offer a shared virtual workspace in which interaction occurs not between a learner and technology, but as many-to-many, interpersonal communication,among people who share a common goal. It has been shown, that students learning in co-operative groups have the ability to generate higher-level reasoning strategies. Furthermore, there is a greater diversity of ideas and more critical thinking in learning teams.

## 2.3 Introduction To Web Based Training Systems

As mentioned in the last sections, Distributed Learning can be enabled by modern computer and networking technologies. Computers without network connection can be used to learn at home to gather facts and information (Information Transfer), such system are called Computer Based Training systems (CBTs). In order to reach learning objectives two and three (Skill Acquisition and Team Learning experience) computers with network connection to a Web Based Training system (WBT) can be used. Web Based Training systems deliver courses via a Web browser, such as Netscape Navigator, via the Internet or Intranet. To gain an imagination about these terms, here is an example for a CBT/WBT supported learning environment:

2.3.1 Example for a CBT/WBT supported Learning Environment

A Distributed Learning environment (a combination of both CBT and WBT) can be formed with the following (logical) system components:

- **Offline Learning Systems (CBT applications)**

  Personal Computers without network connection ('stand-alone'-systems). The courseware is installed on the hard-disc or comes with interactive CD-ROMs. Students work on their own with the computer course in order to enhance their theoretical knowledge. CD-ROM-based applications often have a unique user interface, so you have to consider additional time to get familiar with it.
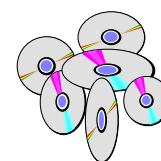
- **Teleconference Systems and 'Netmeeting' applications**

  Computers with network access and proper applications installed can provide virtual meetings and conferences between course participants, including the teacher. There are various possibilities of interaction:

  - Text-only interaction with keyboard input used at low data rates
  - Audio connections
  - Application sharing with other participants or 'whiteboard' facilities
  - Video Conferencing when broad bandwidth is available, e.g. ISDN[4]-line with 2 x 64 kilo bits per second data channels

- **Online Learning Systems (WBT applications)**

  Web Based Training systems offer complete (adaptive and individual) courses via the network, there is the possibility of (threaded) discussions, collaborative working in groups with other students and remote tutoring. Each student has a private working area on the course server, the progress made in each course is shown with some kind of

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[4] ISDN: Integrated Services Digital Network

progress indicator to provide feedback. As mentioned, WBT systems require a web browser, hence the basic navigation scheme is usually familiar to the learner.

Hybrid CBT/WBT solutions

There is often the problem of insufficient bandwidth. Therefore, the major part of the courseware is stored on a CD-ROM at the client side. Such systems are called 'Hybrid' CBT/WBT systems. Only courseware updating and communication is done over the network. This seems to be a good solution when students can access the network only via modem.

User Requirements - Hardware
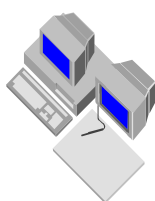
- **PC**: 80486 or Pentium (better) class Windows Personal Computer
- **Mac**: 68040 or PowerPC (better)

- Network Card or Modem
- Soundcard

User Requirements - Software
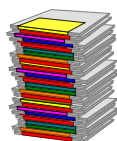
- Web Browser
- Web Browser plug-ins

According to this first example of a CBT/WBT learning environment we can now start to derive general guidelines , aims and tasks for web based training systems:

2.3.2 General Guidelines for a Web Based Training System

- **Provide individual learning environments for each student**
  There must be the flexibility to support individual teaching methods to a diverse and distributed population of learners. This leads to the concept of adaptive courses, which will be discussed later.

- **Provide applications for collaborative group working and learning.**

- **Provide discussion and communication facilities.**

- **Use modern information technologies to prevent learning-time or learning-place constraints.**

- **Enable continuing education and life long learning with modern telecommunications infrastructure.**

2.3.3 Ten Criteria used in evaluating Web Based Training systems

The following ten criteria are used in the judging of the semi-annual Multimedia and Internet Training Awards sponsored by the Multimedia and Internet Training Newsletter (http://www.multimediatraining.com/medalist.html) :

1. **Content**
   - Does the program include the right amount and quality of information ?

2. **Instructional Design**
   - Is the course designed in such a way that users will actually learn ?

3. **Interactivity**
   - Is the user engaged through the opportunity of input ?

4. **Navigation**
   - Can users determine their own way through the program ?
   - Is there an exit option available ?
   - Is there a course map accessible ?
   - Is there an appropriate use of icons and/or clear labels so that user don't have to read excessive documentation to determine program options ?

5. **Motivational Components**
   - Does the program engage the user through novelty, humour, game elements, testing, adventure, unique content, surprise elements, etc ?

6. **Use of Media**
   - Does the program appropriately and effectively employ graphics, animation, music, sound, video, etc. ?
   - Is the gratuitous use of these media avoided ?
   - Is the soundtrack really annoying ?

7. **Evaluation**
   Is there some type of evaluation, such as:
   - Completion of a simulation ?
   - Mastery of each section's content before proceeding to later sections ?
   - Final exam ?
   - Section quizzes ?

8. **Aesthetics**
   - Is the program attractive and appealing to the eye and ear ?
   - Does the structure of the screen add to the program ?

9. **Record Keeping**
    - Are student-performance data recorded, such as time to complete, question analyses, and final scores ?
    - Is the data forwarded to the course manager automatically ?

10. **Tone**
    - Is the program designed for the audience ?
    - Does it avoid being condescending, trite, pedantic, etc. ?

2.3.4 Development requirements of Web Based Training Systems

Project Manager	Co-ordinates all actions between team members. Has to cope with diverse work styles and personalities
Instructional Designer	Has experience with computer-delivered education
Programmer	Creates all web applications needed for the system, e.g. discussion forums and authoring tools.
Author	Uses authoring tools to create course content
Graphic Artist	Design of logos, icons and parts of the user interface
Subject matter expert	An expert on a specific subject
Web master	Maintains the course server

2.3.5 Advantages of Web-Based Training

▪ **Learning Flexibility and Convenience**

Learners can proceed through a course at their own speed and at their own place (familiar surroundings). Furthermore, training can be accessed at any time. Students can view the course materials at any time and rate. There is no need to schedule classes, instructors, or classrooms. Advanced systems automatically adapt to the user's learning needs (use of adaptive courseware).

▪ **On-The-Job-Training (OJT)**

WBT systems are effective for instructors, because they spend less time lecturing. In general, On-The-Job-Training courses are instructed by a fellow worker. Hence, less lecture time reduces the time the instructor is taken away from his own job.

▪ **Platform Independence**

Web Based Training systems can be accessed with standard Internet web browsers, available for a number of platforms, for example Windows, Mac, Unix or OS/2. Thus, there is no need for authoring a specific application for each platform. Many students are already familiar with web browsers so they are already familiar with the user interface Browsers and simple WWW servers are available for free on the Internet.

▪ **Easy Updates**

Changes in the courseware have to be made only at the course server. Courseware material can be used as reference material with updates immediately available to everyone. There is no need to distribute new hardcopies or CD-ROMs, for example.

▪ **Accessibility**

Web Based Training can be accessed from any computer anywhere in the world connected to the Internet.

▪ **Courseware Authoring**

The standard document format of the WWW, HTML, is very easy to learn. Course authors need little training before producing course material. It is easy for the course author to include links to other materials.

▪ **Cost Reduction**

Web Based Training systems will save travel costs and time. Due to the availability of the course at the employees' desktop there is no need to travel to remote training centers.

WBT Advantages: Summary

The use of sophisticated CAL/WBT system will have the following effects on learning:

Increase of...
- Learning speed
- Learning flexibility
- reach of learning and training

Reduction of the costs that come along with offering classroom training as the only delivery vehicle.

2.3.6 Disadvantages of Web Based Training Systems

- **Reduction of social contacts**

WBT systems should not completely replace the physical contact with the human teacher in a classroom with human classmates. A computer terminal will certainly never be able to replace a friendly face. In general, the increase of information technology will not only have positive impacts on our society.

- **Development of Courseware can be expensive**

There have not been many experiences with Web Based Training yet. Thus, implementing new technologies takes a certain amount of time and money. Of course, there are a few simple systems around, but these applications are too static and interactivity is limited.

- **Not all subjects can be taught with WBT**

There are some topics which are taught better in the traditional way. Dealing with emotional issues can only be learned when people meet physically in a classroom. In general, WBT systems should not be applied to replace learning methods that already work well.

- **Limitations of network bandwidth**

Good hypermedia courseware demands for a high data rate on the computer network. The learning process can be affected by the slower performance and download waiting times using insufficient network technology. This problem arises in the Internet, where more data traffic jams occur than in a company's Intranet.

2.3.7 Fields of Application
Where do Web Based Training systems apply ?
- Corporations
- University
- High Schools
- For private use

2.3.7.1 Corporate Setting: Employee Training

In corporate settings, Web Based Training systems can be used for employee training. Traditional learning methods would have many disadvantages in corporate settings, as follows:

- Learners (employees) are often dispersed in terms of time and location.
- Costs of training facilities and lost work time have to be considered.
- The number of learners reached by the traditional methods is limited.

Distributed learning with Web Based Training systems and proper telecommunications infrastructure (Intranet/Internet) yield a much better result in this learning environment:

Advantages of Distributed Learning in the Corporate Setting

- Reduction of instructor costs.
- Reduction of student (employee) travel to learning training facilities.
- Increase of productivity.
- Delivery of learning experiences directly to the employees' desk (workstation).
- No fixed learning schedule, learning-on-demand.

Real-World Examples Of Distributed Employee Training

To see how these theoretical aspects of Web Based Training systems and Distributed Employee Training apply in real-world applications and projects, we take a closer look on the 'TECAR' project supported by the European Union. There is a strong demand in the European automobile industry for the use of new technologies to make employee training more efficient and less expensive. The TECAR project (Training Network For The European Car Industry) provides telematics-based applications to meet the training needs of employees in this area. Services supporting access to a network of distributed multimedia training material for on-demand-training are being developed. There are real-life experiments at two major European car manufacturers. Mercedes and Fiat employees will be able to perform autonomous and group work. On-demand access will give the trainee a more active role than in currently used training methods.

TECAR – Training Network for the European Car Industry

http://www.tecar.condat.de

Mercedes-Benz is working on a large Intranet project since March 1996. With support of the European Union project leader Fritz Pollack and advisor Carsten Kindermann of the Berlin Condat Gmbh are going to set up a project called 'Training Network for the European Car Industry (TECAR)'. The TECAR project is a 4th Framework Telematics Applications Project supported by the European Commission, DG XIII, Education and Training. The task is to form an Europe-wide training facility for service workers via an uniform communication system. The training efforts for about 60.000 employees are supposed to be reduced dramatically, also the travelling costs. The central preparation of teaching material will be replaced by de-central working methods supported by Tecar-Intranet applications. Amongst Mercedes-Benz Marketing Academy at Esslingen the Fiat-Instruction facility Isvor (Turin) is also a participant of the Tecar project. The Italians chose a factory with around 400 employees at Melfi to test the system. The Web-Server, a Groupware- and a SQL-Database-Server are installed at Stuttgart. Due to the company wide application of Picturetel videoconference systems, Microsoft-Netmeeting was chosen for application sharing, Netscape Navigator as web browser. Problems are document transfers between LAN- and WAN constellations. See [Leonberg 1997].
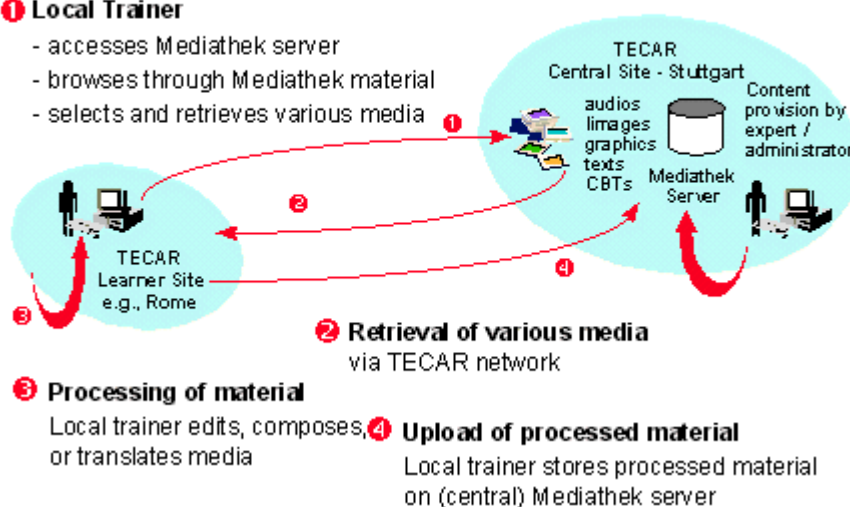
TECAR On-demand Services

1. The Media Library ('Mediathek')

The Media Library will make all kinds of training and raw materials available for all actors involved in the preparation of courseware material.

TECAR Slide: 'Mediathek'. http://tecar.condat.de/gifs.html

2. The Courseware Repository

The Courseware Repository is a self-contained multimedia archive for courseware-on-demand. It is used to deliver courseware-material to remote training sites. Target groups for this service are trainers and trainees (blue collar and white collar personnel) at distributed training sites.
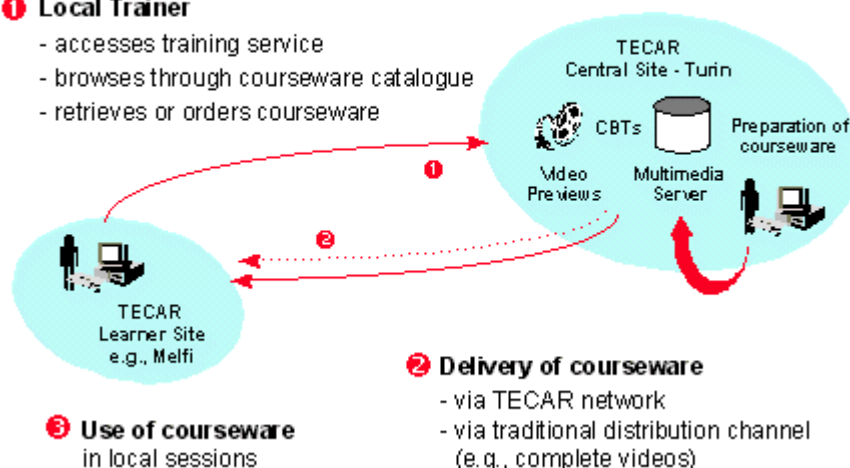
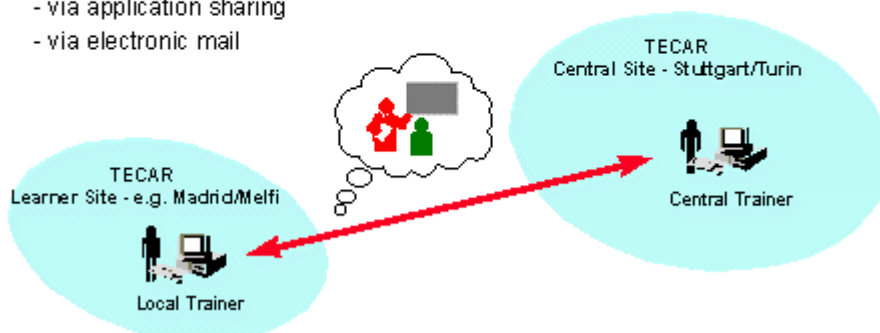TECAR Slide: Courseware Repository. http://tecar.condat.de/gifs.html

3. The Helpdesk Service

With the Helpdesk Service users have direct support from trainers, experts or other users. There are several possibilities for co-operative working: Discussions and feedback via e-mail, Newsgroup discussion boards, video conferencing and application sharing.

TECAR Slide: Helpdesk Services. http://tecar.condat.de/gifs.html

2.4 Learning: The Concept of Adaptive Courses and Customisation

Due to individual learning habits and cultural backgrounds several instances of a lecture have to be created to provide the proper learning environments for each student. It is up to the system and its underlying algorithms to decide dynamically which version fits best to what kind of participant. Additional reading: [📖 Dietinger 1997b]

2.4.1 Examination of the Student's Knowledge and Learning Habits

Profiler

First of all, the system must gather relevant information on the participant's learning habits, the level of education and the knowledge so far.

The relevant data query contained in the profiler can look like this:

- **Level of education**
- **Knowledge**
- **Cultural background**
- **Learning habits**
- **Department**
- **Position**

It is clear, that these information about a course participant is confidential and must not be passed to third persons. The reason for the profiler must be explained to the student, otherwise the query would not be filled out correctly. Nevertheless, the data can also be used to design some sort of career plan by suggesting several courses to the student. Some parts of the profiler information may be viewed and changed by the participant at some later time.

The query can be implemented by using simple HTML[5] forms together with Common Gateway Interfaces (CGI). The data can be stored in standard database systems, say in an Oracle database for statistical purpose, or by using sophisticated server software like Hyperwave.

One method to examine learning habits is using a test following the so called 'Meeker' technology. This test has to be programmed within the Java Virtual Machine, because HTML forms are insufficient due to the lack of a timer module which is a significant prerequisite. Users must pass each test page within some time specified otherwise the system will switch to the following page.

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[5] HTML: Hypertext Markup Language. For further information see [💻 Berners-Lee]

2.5 Courseware: Important Properties and Attributes

Courseware is a generic term for all kinds of educational software. Important properties, attributes and data structures suitable for courseware design are described in this section.

General Guidelines

When designing courseware or whole learning systems, the following guidelines must be taken into consideration:

- **Examination Of Learning Habits And Knowledge – Assessment Test**
  To test a student's learning habits and knowledge, assessment tests of general academic knowledge and skills can be used. Assessment tests usually include material covered in courses taken during the general education stages.

  Assessment Test – Short Overview

  - About 100 Questions in three hours (with a short break) as an average
  - Measure knowledge in Humanities and Social Science
  - Natural Science: college level reading and writing; mathematics
  - Critical Thinking
  - Scoring: numbers of questions answered correctly

- **Adaptive courses are using alternative clusters (course units)**
  Thus, several instances of a lecture have to be created. The training system dynamically decides which version fits the needs of the user best (Dynamically adjustment of content and style according to the students knowledge)

- **Test/Exam at the end of a chapter or at the end of a whole course.**
  The test can be used either as a feedback for the student or to set the final marks for a course.

2.5.1 Courseware Data Structure

In order to store the course content electronically on a hard-disc, CD-ROM or a web server, sophisticated data structures and objects must be used. It would be a good idea to start with an object-oriented, hierarchical approach. Important issues on data structures for courseware design can be found here:

Use an object-based, hierarchical data structure. Most systems use the following terminology: The *basic items* of a course are hypermedia documents and document folders. A certain set of *basic items* form a *Course Module*, like a self-closed chapter of a book. Finally, the course author defines a set of *Course Modules* in order to create a whole course, often called *Course Container*. These data structures can be enhanced with various kinds of meta-information, like access rights or additional content and displaying

information. The basic fundamentals for a web based training system are offered by the current version of Hyperwave.

2.5.1.1 Course Modules

Course Modules contain all items needed for a course chapter. These items are hypermedia data objects and documents like text documents, audio clips, graphics, animation and videos. There is also a possibility to insert alternative course modules in order to allow adaptive courses.

2.5.1.2 Course Container

All Course Modules are stored in a data object called 'Course Container', it is the parent collection of all course objects.

2.5.2 Course Control Mechanisms

In general, there is also a need for a course control mechanism, which can be used for the following intentions:

Course Guiding: Though the student is allowed to access all course modules at his will, the 'Course Guide' suggests a path through the course which fits best to the student's knowledge.

Example: In an electronics course it does not make sense to learn about the specific properties of a transistor without having completed the basic course modules on Ohm's and Kirchhoff's laws. In this case, the Course Guide will suggest a proper learning path. In Hyperwave, the Course Guide is given by the sequence structure.

Exams / Self Assessment Tools: In order to complete a course module, students have to attend an *exam* at the end of each lesson. The time for each test is given by the course control mechanism. Students can use their exam results as feedback for their learning strategy or it can be used directly to set the final marks.

You can find a sample exam in the Appendix (page 105). It has been taken from a WBT course for employee training at the Lawrence-Livermore National Laboratory (LLNL; see http://www-training.llnl.gov/wbt). The exam is a multiple-choice test programmed with a CGI-script to evaluate how much of the information the student has absorbed (here: LLNL New Employee Safety Orientation). When the test is finished, it is automatically scored and the results are e-mailed to the appropriate training administrator.
[Lager/Koopman 1997]

Progress Indication: The control mechanism keeps track of each step the student takes in a course. This data is displayed, so that the student is able to preserve orientation. Various navigation features can take advantage of this information, too.

Hyperwave offers various data structures and possibilities for course control. E.g. Sequences, enhanced with PLACE-templates[6] and Common Gateway Interfaces (CGI) to implement features like progress indication.

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[6] PLACE is a meta-HTML language, with which the appearance and function of WaveMaster's user interface can be configured. The name PLACE comes from the so-called placeholders used in the language
 [Hyperwave 1997a]

3 CAI/WBT Projects Today

Nowadays there is a large number of projects concerned with Computer Aided Learning (CAL), Web Based Training (WBT) and Computer Aided Instruction (CAI). In this section I will present some interesting examples of such projects to see the various fields of WBT/CAL applications. First, some lines about the Apple HyperCard application, a milestone in sophisticated, good quality courseware authoring with hypermedia.

CAL 'Milestone': Apple HyperCard

In early stages, Apple encouraged all educational users to produce courseware using the HyperCard application (available on Macintosh platforms, 1987), which was distributed for free. HyperCard was one of the first applications to produce Hypertext[7] documents. The program was distributed for free on each Macintosh computer. Scientists, teachers and artists used HyperCard to put their knowledge into hypertext documents and so called 'HyperCard-Stacks', formed by collections of such documents. The HyperCard-Stacks were distributed for no charge over various bulletin boards and other online services, hence Mac users had access to a huge amount of hypertext-based information packages. Furthermore, graphics, audio and video clips could be inserted into HyperCard documents. HyperCard (and its clones) provided an early concept of 'Hypermedia'[8]. Further information: See Apple's WWW site at http://www.apple.com
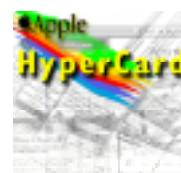
Research
Recent research results and trends in the field of CAI can be found in the proceedings of the ACM SIGCUE, a Special Interest Group of the largest scientific computer association, the ACM:

ACM Special Interest Group for Computer Uses in Education - SIGCUE
The Association for Computing Machinery (ACM) has a Special Interest Group for Computer Uses in Education (SIGCUE; http://www.acm.org/sigcue).This Special Interest Group brings together educators at all levels who are interested in using the computer and related technology to aid the educational process. Focus is on the discussion of concepts, methods and policies that relate to the central issues of instructional computing. SIGCUE also publishes a newsletter.

CAL/WBT Projects: Some Examples
In the following paragraphs I will describe some interesting and sophisticated CAL/WBT projects and programmes to see what is happening in the area of CAL/WBT today.

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[7] Hypertext: The term hypertext was coined by Ted Nelson in 1965 in connection with the Xanadu system.

[8] Hypermedia: Extension of hypertext into the multimedia field. The term refers to pieces of documents of various types with interactive links between (parts of) them. The origins of hypermedia date back to 1945 when Vannevar Bush described a system called 'Memex' in his paper 'As We May Think'.[⊞ Bush 1986]
A very interesting description of Multimedia and Hypertext can be found in Nielsen,J: Multimedia and Hypertext: The Internet and Beyond. Academic Press, San Diego.

3.1 IDEALS

http://ideals.zgdv.de

IDEALS (Integration of <u>DEDICATED</u> for <u>A</u>dvanced Training <u>L</u>inked to <u>S</u>mall and Medium Enterprises and Institutes of Higher Education), a project sponsored by the European Union within the Telematics Applications Programme[9] (for further information see http://www2.echo.lu, The Information Market Europe Home Page), gives 'an approach to web based remote training' [Lopes 1996,1]. It is aimed at installing and positioning flexible, on-demand, telematics based distance learning and training services on the market. IDEALS is coordinated by the 'Zentrum für Graphische Datenverarbeitung e.V. (ZGDV)' at Darmstadt, Germany.

Education and Training Programme of the European Union

IDEALS is part of the Education and Training Sector of the Telematics Applications Programme ('...Improving Access to Lifelong Learning for All European Citizens', see http://www2.echo.lu/telematics/education/en), financed by the European Union. Activities vary from developing tools for active document authoring to using multimedia in open distance learning.

IDEALS: Tasks, Aims and Benefits

- Satisfaction of the training and learning needs of organisations and universities. IDEALS is aimed at <u>Small and Medium Enterprises</u> (SMEs) and <u>Institutes of Higher Education</u> (IHEs).
- Integration of web tools and other learning oriented tools developed within IDEALS
- Cost-effective (co-)authoring of courses and flexible, cost-effective learning for users, fast knowledge transfer, improvement of competitiveness.
- Joint creation of courseware by using tools for co-operative authoring and communication
- Learners should stay at their workplaces ('<u>on-the-job</u>') or at home. They should learn whenever they choose ('<u>on-demand</u>'), for the length of time they want.
- Support of <u>Group Learning</u> and <u>Remote Tutoring</u>
- Support access to the learning system even in remote areas

The IDEALS System

The IDEALS Modular Training System (MTS) is a Client/Server based architecture (See [Borgmeier]):

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[9]Telematics Application Programme: This programme is aimed at stimulating research and technological development in applications of information and/or communications technologies. There are 13 sectors, including Telematics for Education and Training (http://www2.echo.lu/telematics/education/en), Telematics for Libraries, Language Engineering and Information Engineering.

- **Server**
  IDEALS MTS is a server that supports all learning oriented operations requested to it by a normal web server. The servers are running at the Local Training Centres (LTCs), forming a distributed courseware database (*courseware domain* split across server locations).The IDEALS-MTS server will be based on the Internet and World Wide Web (WWW) technology.

- **Client**
  An IDEALS-specific client application is running at the learner's working place.

- **Network Infrastructure**
  There are two different approaches: ISDN-Networking and satellite data links in areas without or weak communications infrastructure.

The IDEALS Courseware

- **IDEALS Courses**

  The course modules (course contributions) are stored locally at the site of the author of the module. These modules are linked to other, remote contributions in order to create a course. The whole system works with a set of common distributed databases. Each courseware module has a characterisation attribute to facilitate courseware authoring.

  Important terms:

  Course creation 'on the fly': [Ottmann 1995] Courses can be built by putting together modules already present in the distributed databases. The course author creates a so called 'course node', which is used to refer lower level parts of a course.

  Course Node: The Course Nodes list and specify the sequence of modules in a course (virtual links).

  IDEALS Mapping: The distributed courseware database is inquired by the IDEALS MTS at runtime to find a course unit which best fits to the virtual references specified by the course authors in the course nodes. This operation is called IDEALS Mapping.

  Personal Learning Profiles: Learning is a personal activity. Each learner has his/her own learning speed and learning scheme. Therefore, the personal learning profiles are taken into account by the IDEALS MTS. MTS measures and keeps records of the learning speed, success and learner background knowledge and uses this information to adapt constantly to the user's needs. Thus, there can be many different paths and course units - according to each person's specific learning profile – through the course while studying the same subject.

European IDEALS Network

European-wide network of Local Training Centres (LTCs) will be established
<u>Uniform Courseware Domain</u>: The LTCs are interconnected with modems, ISDN, Internet
or even satellite links used in remote areas in order to built a uniform courseware domain
with European-wide access. All LTCs form a Virtual Training Center

Pilot Project for Small and Medium Enterprises (SME)

- Seven courseware providers will jointly create courseware on 'Parametric Design',
  'Telematics Usage' and 'Quality Management'. These courses will be delivered to
  approximately 20 SMEs and about 150 SME trainees will access courseware from
  either their working place or training labs specialised in providing training to external
  customers.
  The SMEs of this pilot project are located in the following European countries:
    - Germany
    - Greece
    - Portugal
    - Netherlands
  Furthermore, 'satellite connections will be tested in remote rural areas'. [📖 Bausch]

Pilot Project for Institutes of Higher Education (IHE)

The following European Universities will jointly create courseware on 'Fundamentals of
Computer Graphics' by using tools for co-operative authoring with on-line communication:

- Germany: Technische Hochschule Darmstadt
- Finland: University of Oulu
- Portugal: Universidade de Coimbra

The courseware will be used by about 200 students. There is also the possibility for <u>Remote
Tutoring</u> and <u>Group Learning</u>.

3.2 Lotus LearningSpace

http://www.lotus.com/home.nsf/tabs/learnspace

There has been some effort at Lotus to design technology solutions and methods which support collaborative learning at any time and at any place. The result is called 'Lotus LearningSpace', a distance education system based on the Lotus-Domino server technology and the collaborative technologies of Lotus Notes. LearningSpace is comprised of interconnected modules, each of which is a Lotus Notes database.

In order to attend the LearningSpace course system, students receive

- **The Course Schedule**
  The Schedule represents the instructional design of a course. It contains the course structure as created by an instructor. Learning objectives are specified here. Time frames (modules to be completed each week, for example) can be inserted in the schedule.
- **The MediaCenter**
  The MediaCenter contains the whole courseware content. It is an electronic knowledge database designed by an instructor. Furthermore, there is access to external World Wide Web resources. Information can be stored in text, video clips, multimedia, CBT, graphics, spreadsheets, simulations and more. Additional meta-information, so-called keyword taxonomies can be applied to facilitate categorising and searching. The MediaCenter supports individual learning styles and needs.
- **The CourseRoom**
  The CourseRoom can be seen as a virtual classroom, an interactive environment, where students have discussions with course mates and with the instructor. Using the CourseRoom, learning teams can collaborate in order to solve problems and tasks. The communication facility ranges from public to private discussions enabling collaborative learning. Asynchronous communication is supported by the use of Notes replication, synchronous communication is done with whiteboard applications and video conferencing.
- **Profiles modules**
  Various descriptions of student and instructor including background information, photographs and information about education, experience and interests are stored in the Profiles module. The Profile module can be used by a student to create a personal Homepage, so that other students can see his/her interests and objectives.

Instructors also receive these modules and furthermore they get an Assessment Manager:

- **Assessment Manager module**
  The Assessment Manager is an evaluation tool for instructors to give feedback on participant performance. Exams, surveys and quizzes can be inserted into the student schedule. The results are sent back to the instructor via e-mail and stored at the Assessment Manager module. Instructors can review, grade and provide feedback to participants privately.

3.3 PLATO

http://www.tro.com

PLATO History

'Plato' was developed at the Computer-Based Education Research Laboratory (CERL), a department at the University of Illinois at Urbana Champaign (http://www.cs.uiuc.edu) in the sixties. At that time computer hardware was very expensive and unsophisticated. One of the reasons why Plato survived such a long period of time might be it's sophisticated record-keeping system, which is very useful for both student guidance and quality control. Later on, there were agreements with the Control Data Corporation (CDC) to develop and market the whole Plato system. Most rights to the name 'Plato' were sold to the CDC at the same time. Eventually, the CDC gave up their efforts on Plato and sold the name and many of their rights to the system to The Roach Organisation (TRO, http://www.tro.com). Today, the name 'Plato' introduces the applications developed by TRO in the CAI field. Generally speaking, TRO's Plato system is the same that was developed by CERL some time ago. Nevertheless, CDC stayed in the CAI business and had to change the names of their CAI product. CDC's version of Plato has been called 'Cybis', the twin-brother of Plato. In the meantime, at the University of Illinois, the CERL department began some kind of new development steps. An advanced, new version of the Plato system was implemented using satellite transmission lines from the central host to the remote terminals. This system was called NovaNET. University Communications, Inc. (UCI), a new company, has been set up to market the NovaNET service. So, the Plato spirit lives on, at various places: at TRO, Cybis at CDC and NovaNET at UCI. Further reading: [🖥 Friedman]

PLATO and the Internet

The Internet offers the promise of universal access to technology-based education and training resources that will have a transforming impact on the nature of education and training. 'In classrooms, offices, and homes, learners have access to a world-wide variety of resources, at their fingertips.' TRO has added to the traditional computer-based learning system a number of Internet applications that allow learners to take advantage of both the power of a workstation and the connectivity of the Internet. The following tasks can be performed by TRO PLATO clients:

- Delivery and management of PLATO courseware via the Internet
- Delivery and management of PLATO courseware via private Intranets
- Web-based instructional tools and reviews
- Web-based communications for enhanced education and training services

PLATO Learning System

The PLATO Learning System offers interactive, self-paced comprehensive instruction and testing specifically designed for adult and young adult learners in a variety of settings:

- Business and Industry
- Secondary Education
- Colleges and Universities
- Workforce Readiness
- Personal Learning
- PLATO Globally
- Canada specific subjects and topics

PLATO Learning System Goals and Objectives

- *Establish and Maintain Clear Standards for What Learners Must Know and Be Able to Do*

  The new PLATO WorkSkills curriculum allows learners to see the relevancy of the academic skills they have learned using the PLATO system. PLATO offers learners additional opportunities to apply their academic and workplace skills by solving real-world problems and completing real-world projects.

- *Implement Assessment to Ensure that Learners are Meeting High Academic Standards*

  To provide learners with a kind of truly individualised, self-paced instruction, the PLATO Learning System includes multiple strategies for assessing each learner's skill gaps and prescribing needed instruction. Learner skills can be assessed by the PLATO 'Manager' at the objective, course and curriculum level. The individual learning path is prescribed for each learner based on that assessment. Furthermore, PLATO has a customised assessment tool that allows course teachers to design their own assessment test by choosing the test objectives, a number of test items and the percentage of mastery.

- *Align Curriculum and Instruction to Standards and Assessment*

  The depth and the scope of the PLATO courseware along with the modular structure allow educators to easily align PLATO curriculum to all essential elements of 'school-to-career'.

- *Prepare and Support Educators to Enable Learners to Reach High Standards*

  An on-going professional development and technical support program is critical to the successful implementation of any computer or web based training system. Thus, TRO is committed to provide clients with the most comprehensive and professional training and

support in the industry. The following components are included with that support: 'The TRO Education Specialist' and the 'Total Software Support Program'.

- *Promote Partnerships and Establish Links Among the Educators, Parents and Business and Industry to Support Lifelong Learning*

TRO Learning offers high-quality, interactive, instructional courseware that will help educators provide learners with the academic and applied skills they need to succeed in our highly competitive global economy.

Screenshot: The TRO-Plato System seen through Netscape Communicator.
http://www.tro.com

PLATO at the New Hampshire Technical College

PLATO was selected for use in learning resource centers throughout the seven-campus network of the New Hampshire Technical College and Institute System. According to Ellen Germann (LRCN State-wide Coordinator, New Hampshire Technical College and Institute System), 'PLATO has provided a distinct advantage to our Learning Centers in helping students to achieve more quickly the goals they have established.'

PLATO's effectiveness lies in the fact that it is easily customised to meet a wide variety of curriculum requirements in an age-appropriate manner. PLATO's implementation has been so successful that the College system has received numerous awards and state and national recognition for its collaborative evaluation and funding efforts and innovative approach to education.

3.4 The JASON Project

http://www.jason.org
http://www.jasonproject.org

The Virtual Field-Trip

The last example of web based multimedia training and learning is the JASON project. Unlike the other learning system described in this section, the JASON project enables students to go on a virtual 'field-trip' to exciting places on our globe. For example, students can virtually join expeditions to the bottom of the sea or interactively control research equipment (see JASON II, for example). There are different topics and expeditions every year. JASON is a good example to inspire students to learning and all kind of scientific subjects with amazing subjects and high quality hypermedia content.

The JASON Foundation for Education is a non-profit educational organisation, the headquarters of JASON is located in Waltham, Massachusetts. JASON has been founded to administer the JASON Project, an educational project begun in 1989 by Dr. Robert D. Ballard (picture to your left) following his discovery of the wreck of the RMS Titanic. After receiving thousands of letters from children who were excited by his discovery, Dr. Ballard and a team of associates dedicated themselves to developing ways that would enable teachers and students all over the world to take part in global explorations using advanced interactive telecommunications. The whole project is sponsored by the JASON Foundation for Education in collaboration with NASA, the United States Geological Survey, the United States Biological Survey and other participating organisations, including EDS Corporation, Bechtel, the National Geographic Society and the U.S. Department of Education.

The mission of the JASON project is to excite and to engage students in science and technology through the use of advanced interactive telecommunication systems. 'Bringing the thrill of exploration and discovery live to students around the world as they participate in an amazing electronic field trip' JASON offers:

- Virtual Field-Trips
- Inspiration for Science and Exploration
- Tele-Presence
- High quality multimedia content
- Learning programs
- Additional information on related topics

The JASON expeditions are supported by professional multimedia material for teachers and award-winning curricula. All field trips feature live, interactive broadcasts from distinctive sites through technologies in robotics, fibre optics, television production, computer science, mechanical and electrical engineering and satellite communications.

Past JASON Project Expeditions
(http://www.jason.org/JASON/HTML/EXPEDITIONS_past.html)

- **JASON I: The Mediterranean Sea**
  http://www.jason.org/JASON/HTML/EXPEDITIONS_JASON_1_home.html
  May 1989. Discovery of the first hydro-thermal vents in the Mediterranean Sea, examination of an ancient Roman shipwreck and retrieval of artefacts from under 2,100 feet of water.

- **JASON II: The Great Lakes**
  May 1990. Comprehensive examination of two War of 1812 schooners on the bottom of Lake Ontario. For the first time, students were able to drive JASON, the Remotely Operated Vehicle (ROV) via two-way satellite link.

- **JASON III: The Galapagos Islands**
  December 1991. The footsteps of Charles Darwin were followed to explore several land and marine sites at the Galapagos Islands. Examination of animals, bird and marine species that are found nowhere else on earth.

- **JASON IV: Baja California Sur**
  March 1993. The JASON team went to two sites along Mexico's Baja California Penninsula. Examination of tube-worms and other organisms living off hydro-thermal vents in the Guaymas Basin in the Sea of Cortez. Study of migrating grey whales in the Pacific Coast's San Ignacio Lagoon.

- **JASON V: Planet Earth**
  http://www.jason.org/JASON/HTML/EXPEDITIONS_JASON_5_home.html
  February 1994. Expedition to the Central American country of Belize. Study of the health of our planet and the effect people have on it. Exploration of life in the canopy of a rain forest and the Western Hemisphere's largest barrier reef. Use of computer modelling to map a cave system and an ancient Mayan city.

- **JASON VI: Island Earth**
  http://www.jason.org/JASON/HTML/EXPEDITIONS_JASON_6_home.html
  February 1995. Special focus on the Big Island of Hawaii. The JASON team witnessed the largest surface lava flow in that area for 25 years and looked for evidence of volcanic activity elsewhere in the solar system through NASA's infrared telescope. Study of the unique biology of Hawaii.

- **JASON VII: Adapting to a Changing Sea**
  http://www.jason.org/JASON/HTML/EXPEDITIONS_JASON_7_home.html
  January/April 1996. Two expeditions to the Florida Keys. Exploration on how life adapts to a changing sea. Examination of climate changes affecting coral reefs, sharks sensing water both shallow and deep, and the bio-mechanics and behaviour of crocodiles. Utilisation of tools as the Navy's NR-1 nuclear submarine and a unique underwater habitat known as Aquarius.
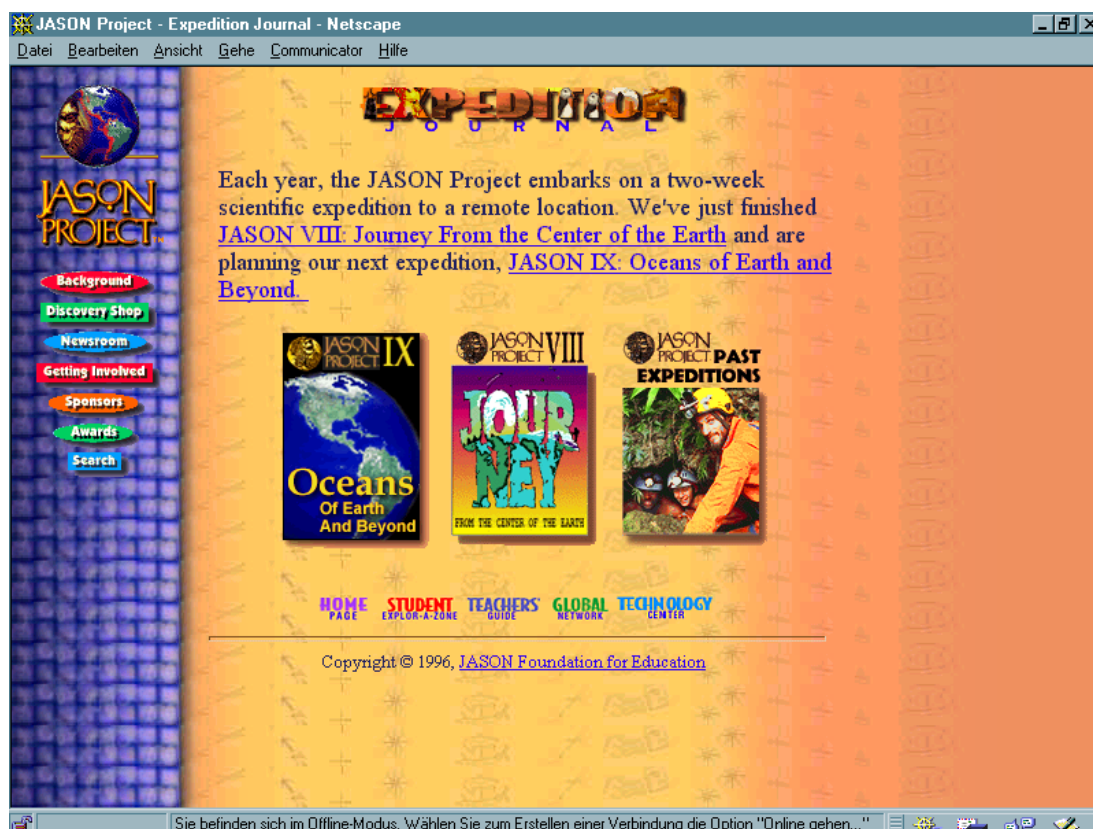
Screenshot: The JASON Expedition Journal

Further examples of Web Based Training Systems can be found at http://www.multimediatraining.com/links.html ('Links To Web-Based Training Sites')

4 Computer Supported Collaborative Work (CSCW)

4.1 Introduction

The strengths and capabilities of information technology based on communication systems and the application in business are described and discussed in this section. Computer Supported Collaborative Work is concerned with the following topics:

- **How do people work together in a group ?**

  In every organisation there is a super-ordinate goal to achieve, for example production of high quality products or scientific research at universities. The whole organisation is broken up into smaller sub-parts or departments (this scheme goes on, departments can be divided into sections and sub-sections). Hence, each part of the whole organisation has its own specific sub-goals to achieve. Workgroups consisting of two or more workers are formed to fulfil a certain task, this can be the design of a human-computer interface for a computer application, for example. Workgroups must be very flexible, they can exist for a very long period of time or just for a few days, depending on the task. All members of a workgroup must co-operate, even if they come from different scientific disciplines.

- **What tools and equipment are needed for group work ?**

  Workgroups can only be productive when the members of the group have meetings and discussions when problems arise. Meetings can be used for brainstorming, decision making, exploration or for informational and presentational tasks. So, meetings are very important and we must have a closer look on this issue:

  ➢ **Meeting Preparation**

    Classic scenario: Everyone of the workgroup has to be informed by telephone or mail when a meeting takes place. This requires to set dates (time and place), informing everyone of the meeting and distributing information to the attendees (agenda, minutes, project reports).

    CSCW: Preparation and meeting information can be done with email and hypermedia information systems (project documents can be stored and distributed via computer network). Meeting schedules can be automatically arranged with computer programs.

➢ **The Meeting Room**

Classic scenario: A room large enough to seat all participants of a meeting has to be organised. Writing material, overhead projector or blackboards for drawing sketches should be available.

CSCW: Using information technology, there are no more place constraints. People do not have to go to a centralised meeting room, they can use conferencing software installed on desktop computers at their working places and office rooms.

➢ **The Meeting**

Classic scenario: All items on the agenda are discussed face-to-face. When decisions were made by the group, specific tasks will be assigned and delegated to the members of the meeting. *Decision making scenarios* are not always easy because junior group members may be intimidated or suppressed by more powerful colleagues. Tea and coffee breaks are also an important part of meetings. Coffee breaks are good opportunities for meeting participants to get to know each other better.

CSCW: CSCW applications can provide shared workspace, secret ballots for decision making and electronic document management, e.g. version control (EMS – Electronic Meeting Systems)

CSCW supports dispersed co-operation between group members without time and place constraints. All communication is done via computer network. It is also possible to use computers to enhance face-to-face meetings.

CSCW research topics: Summary

- Dispersed co-operation via computer networks
- Synchronous (in realtime, e.g. 'chat') and asynchronous communication (e.g. e-mail)
- Shared applications and workspaces (e.g. 'whiteboards')
- Support of all kinds of group work activities

4.2 CSCW Components, Scenarios and Examples

4.2.1 Groupware

The term 'Groupware' covers the following types of computer applications:

- Email
- Joint preparation of hypermedia documents
- Shared, virtual workspaces and user interfaces
- Conferencing systems (audio and video)
- Distributed document databases
- Use of Hypermedia and the World Wide Web

4.2.2 Computer Conferencing

Computer conferencing software can be very different, it ranges from simple text conferencing systems to audio and video supported multimedia systems, depending on available computer hardware and network bandwidth. Computer conferences can also provide some utilities to structure the discussion. Discussion articles can have the following attributes: Generalisation, supporting argument, question, answer, example, counter argument and so on. Conferencing systems can be classified into synchronous and asynchronous systems:

1. **Synchronous**
   Discussion / Conferences take place in realtime. These forms of communication are suitable for brainstorming and problem solving. Graphical interfaces can support shared workspaces, so-called 'whiteboards'. Disadvantage: All participants have to be online at the same time.

2. **Asynchronous**
   Communication with time delay, e.g. E-mail or Usenet newsgroups. Asynchronous systems are a good solution when there are many discussion participants and problem solutions are not needed immediately.

4.2.2.1 The International Multimedia Teleconferencing Consortium (IMTC)

URL: http://www.imtc.org

The IMTC brings together all organisations involved in the development of interactive, multimedia teleconferencing products and services to help create and promote the adoption of industry-wide interoperability standards. It is a non-profit corporation composed and supported by more than 140 organisations from North America, Europe and Asia. The IMTC is currently focused on multimedia teleconferencing standards adopted by the International Telecommunications Union (ITU, http://www.itu.ch), that are ITU-T T.120, H.320, H.323 and H.324 standards.

IMTC Activity Groups

There are several activity groups which do research in the following areas:

- Data Conferencing
- Internetworking & Network Services
- Marketing
- Network Transport End-to-End Quality of Service
- Packet Network Conferencing
- Switched Network Conferencing
- User and Applications Conferencing
- Voice over IP (VoIP) Forum

4.2.3 Multimedia Teleconferencing Standard H.323

The ITU specifies several standards and core technologies for multimedia teleconferencing: ITU-T T.120, H.320, H.323 and H.324.

- T.120: Real Time Data Conferencing (Audiographics)
- H.320: ISDN Videoconferencing
- H.323: Video (Audiovisual) communication on Local Area Networks (LAN)
- H.324: High Quality Video and Audio Compression over POTS[10] modem connections.

H.323 Overview

The H.323 standard is an extension of H.320, which addresses videoconferencing over ISDN and other circuit switched networks and services. H.323 is a logical and necessary extension of the H.320 standard to include Corporate Intranets and packet switched networks generally. Because it is based on the Real-Time Protocol (RTP/RTCP) from the IETF[11], H323 can also be applied to video over the Internet.

4.2.4 Available Teleconferencing Applications For Windows 95/NT

4.2.4.1 Netscape Conference

URL: http://search.netscape.com/comprod/products/communicator/conference.html
Netscape Conference comes together with Netscape Communicator, the most popular World Wide Web browser. Conference is a real-time multimedia communications tool for Intranet and Internet users.
Features
- Uses H.323 desktop conferencing standard. Thus, Conference works with other open standards-based communication tools
- Full-duplex audio-conferencing
- Text Chat
- File transfer
- Shared Whiteboard

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[10] POTS: 'Plain Old Telephone System'
[11] IETF: Internet Engineering Task Force

4.2.4.2 Microsoft NetMeeting 2.1

URL: http://www.microsoft.com/netmeeting
License: Freeware
Features

- Real-time voice and data communication via the Internet
- Text chat
- Shared applications between two or more people
- File transfer
- Whiteboard

4.2.4.3 Enhanced CU-SeeMe 3.1

URL: http://www.cu-seeme.com
License: Shareware
Features

- Video, Audio and Text chat possible
- Color multi-point video-conferencing using TCP/IP
- Shared Whiteboard available
- Support of various connection speeds

4.2.4.4 GatherTalk 1.5

URL: http://www.cixt.cuhk.edu.hk/gtalk
License: Shareware
Features

- Teleconferencing over the Internet
- Supports even slow modem connections. (3 people conferencing at 14.4kbps and 5 people conferencing at 28.8kbps)

4.2.4.5 PowWow 3.3

URL: http://www.tribal.com
License: Freeware
Features

- Audio or text conference between up to 7 people
- File transfer

This was a short summary of computer conferencing software for Windows 95/NT available for free (Freeware/Shareware) on the Internet. You can find more teleconferencing and communication applications at
http://tucows.univie.ac.at/direct95.html

4.2.5 Virtual Companies

The co-operation between companies with different core competence demands a sophisticated communication infrastructure. Nowadays modern information technologies allow a wide spectrum of interaction capabilities, like (among other things) advertising ('Electronic Commerce') over the World Wide Web (WWW), teleconferencing or data exchange via electronic mail. The target group for such systems are small and medium - sized enterprises on the European domestic market (European Union) which are working

together on large projects forming a synergy and therefore need suitable communication networks. New communication technologies and company networking over data links make it easier even for small companies to participate on large business projects and to compete with the 'global players'. Therefore, all companies, which are working together with the support of shared applications and teleconference systems, form a so called 'virtual company'.

Such a synergy (or often called <u>Virtual Companies</u>) of many different companies needs the following capabilities:

- **Administration of Project-Data**
  Synergy forming companies can administrate all data and information ('Project Containers') needed for their common projects by using public telecommunication-systems, like the Integrated Services Digital Network (ISDN) or the Internet. The objects contained in a project container can be text-documents from word processors, spread sheets, CAD-Documents, various graphics, sounds and movies.

- **Project And Workflow Management, Task Assignment**
  Quality control and management, like the ISO-9001 standards. [Meleschnig 1997] gives a good overview on the ISO-9000ff standards.
  See [Raetzsch 1997] and [Ogris 1997] for a comprehensive introduction to modern workflow management technologies.

- **Data Consistency**
  Project Containers, Web pages and other electronic documents must be held in a valid state and up-to-date.

- **Data Security**
  Password strategy, firewall[12] machines and data encryption.

- **External Data Management And Search Facilities**
  Sophisticated product data bases and information systems.

- **E-Mail, Application sharing and video conference systems**

Companies with CSCW and Groupware experience:

- *Sun Microsystems Inc.*, Mountain View, California
  http://www.sun.com Hard and Software including firewall machines and Intranet/Extranet services.
- *Siemens Nixdorf* Information Systems AG, Munich, Germany
  http://www.sni.de
- *Space Works Inc.*, Rockville, Maryland
  http://www.spaceworks.com Development of Electronic Commerce Software

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[12] Firewall: Gateway-Computer between two networks, controls data traffic and prevents unauthorised access to resources within the network protected by the Firewall.

- ***Progress Software Corp.***, Bedford, Massachusetts
  http://www.progress.com Intranet Development Tools
- ***PFN Inc.***, Cambridge, Massachusetts
  http://www.pfn.com Intranet software and services
- ***Information Dimensions Inc.***, Dublin, Ohio
  http://www.idi.oclc.org Document management software
- ***Hyperwave Research and Development***, Graz/Munich
  http://www.hyperwave.com Sophisticated 'second generation' web server development

4.2.6 Sales Force Automation Systems

Another area in connection with Computer Supported Collaborative Work is **Virtual Selling** or **Computer Aided Selling (CAS)**. CAS is intended for use in field service to provide a powerful tool to the sales agent. Equipped with a **Sales Force Automation System** the sales agent is able to handle all information and data needed to satisfy the requirements of the client in place and in time. In order to compete with others on the market, companies nowadays try to gain as much flexibility as possible. Almost 120 CAS software packages are currently on the German market available among various other products created by companies on their own. Though, in reality the systems often do not yield the planned results. Nevertheless, experts say that we are on to a gigantic Computer Aided Selling market in the next years. Further reading : See [📖 Herrmann 1997]

Following components are needed in order to form a Sales Force Automation System:

- **Opportunity Management Systems**
  Task: Organise and collect all available information for a possible deal.

- **Marketing Encyclopedia Systems**
  Task: Provide online-access to all products- and competition data, support of vendor tools. The sales agent of a company should be able to give ad hoc client specific presentations and information.

- **Product Configuration**
  Task: Products can be „tailored" and assembled to satisfy the needs of a client just in time and place. Ideally the client is able to control the configuration by himself becoming his own product developer.

- **Team-Selling Function**
  Task: Employees of multiple departments are included in the selling process (Team Selling). Technical requirements are broad data bandwidths, data base replication and synchronisation and furthermore workgroup capabilities on the computer system.

Communication equipment used by the sales agent operating in the field and a possible operating scenario:

Notebook or Handheld PC (see picture) with modem and cellular phone are used to connect to the company's database system or any other computer network needed to do the job. Software Agents[13] installed on the PC download all relevant data and information. This may include news, all kinds of documents and even whole multimedia presentations. Another Software Agent supports the sales agent in order to take the shortest route to the client on the freeway. Arrived at the client, the sales agent can connect via videophone to the production facility, so that client and producer can directly discuss on the product. Of course, we should keep in mind that this is merely a vision today, but it is not so far away as one may think.

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[13] Further reading on so-called 'Agents': Agents that reduce work and information overload by Maes, 1994. Communications of the ACM, 37(7).

4.3 Network Security

All the applications and capabilities of modern telecommunication illustrated above give us overwhelming possibilities in business and economy. But, one should never forget the risks and pitfalls lurking in all that technologies. Due to certain technical restrictions, in networks like the Internet it is and will be possible for third persons to intercept, fake or do whatever damage to confident data. To users, a network often looks like a black box where data goes in and magically pops out somewhere else without being accessible to someone else on its way through. Currently, almost all traffic is still transported unencrypted over the network (since the networks themselves do not provide such service automatically) and is thus accessible to many people requiring only a minimum amount of skill and technical knowledge. Thus, it is strongly recommended to take care of that kind of problem in order to reach a high level of security.

'Trivial' Attacks in TCP/IP Computer Networks (Internet)

- **Attacks within the broadcast domain (Local Area Network)**
  With proper technical tools data can be accessed or manipulated by directly connecting to the LAN wires.

- **Network protocols which do not need authentification**
  There are still some old network protocols without authentification mechanism, e.g. the Trivial File Transfer Protocol (TFTP). This can be used to gain unauthorised access to remote computers.

- **Bugs and features in implementations**
  Due to the complexity of network and computer software there are a number of bugs and features (known and possibly unknown). System specialists can misuse this knowledge to manipulate remote computers. Example: Privileged ports; Bugs in the sendmail and fingerd daemons.

- **IP-Spoofing**
  Attackers pretend to have someone else's IP-address.

- **Application Protocols**
  Some Examples:
  Finger – Attacker can gather information about user accounts
  SMTP (Simple Mail Transfer Protocol) and POP (Post Office Protocol) – SMTP has no proper authentification scheme, thus faked e-mails are possible. Plain text passwords are used with POP, they can be stolen easily via the network. The same is true for FTP and Telnet.
  DNS,ICMP – The Domain Name System and the Internet Control Message Protocol can be misused to gather information about network hosts. Redirected messages are possible.

Data Encryption - The Background

In the last paragraphs we have seen that there are many security leaks in the Internet. A good approach to solve this problem is data encryption. Data encryption guru Phil Zimmermann (Inventor of PGP) says: 'It's personal. It's private. And it's no one's business but yours. You may be planning a political campaign, discussing your taxes, or having a secret romance. Or you may be communicating with a political dissident in a repressive country. Whatever it is, you don't want your private electronic mail (e-mail) or confidential documents read by anyone else. There's nothing wrong with asserting your privacy. Privacy is as apple-pie as the Constitution.' [PGP for Personal Privacy, Version 5.0 User's Guide for Windows, page 81]

In order to secure confident data on a computer network it is obvious to apply encryption methods. Only authorised persons with the proper 'key' (The encryption key is mostly a bit string; the safety of the encryption depends on the number of bits used) are able to decode the information. Third persons without knowledge of the key would only get meaningless data trash. In the United States common 40-bit and 56-bit encryption technologies are nowadays available, but federal agencies (like the FBI,CIA or the NSA) hold a 'master key'. The main argument for this policy is that criminals and terrorists could use the encryption systems for their aims, therefore government agencies must have the means to decipher suspect data traffic.

In general, data encryption algorithms are treated in the United States like military secrets and are not allowed to be exported to foreign countries without explicit permission of the government. Nevertheless, a small group of computer 'Hackers' (if you want to read further on Hackers, Internet Security and Computer crime, take a look on 'Firewalls and Internet Security' [Cheswick 1994] was able to decode an email message encrypted with 56-Bit technology based on the Data Encryption Standard (DES) within 5 months, though. Thus, encryption experts give advise to use 128-Bit encryption systems instead. There are special export conditions for 128-Bit technologies in the Secure Socket Layer[14] (SSL), though the code must be available to the government agencies. The „Security and Freedom through Encryption Act" is a proposal in the United States supported by the Business Software Alliance (BSA) to loosen the tough restrictions concerning data encryption. There are special government agreements with Microsoft and Netscape to integrate 128-Bit technology in export Internet applications like the Internet Explorer and the financial software package Microsoft Money.

The frequently asked questions (FAQ) on web security aspects can be found at
http://www-genome.wi.mit.edu/Web/faqs/www-security-faq.html .

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[14] Further reading on the SSL: The Secure Socket Layer by Hickman and Elgamal.
http://home.netscape.com/newsref/std/SSL.html

5 Web Based Learning and Teaching Systems with Hyperwave

The Hyperwave server environment is very suitable for such pretentious projects like network based learning and instruction systems. Before we have a closer look on the various development stages of Hyperwave-based teaching applications I will give an introduction to the Hyperwave server system and describe especially the important differences to an 'ordinary' WWW server.

5.1 Introduction to Hyperwave and Hypermedia

This section will give you an overview about the most important Hyperwave features and outlines the differences to 'ordinary' WWW server systems. Hyperwave provides powerful search facilities and a highly sophisticated structuring of information which goes far beyond hyperlinking, link consistency and multilinguality.
In contrast, ordinary web servers are using HTML pages that were uploaded to the server without any proper link maintenance facility. Hence, these links are nothing more than simple references to another HTML page. If that page is erased, a link to a non-existent document remains, this effect is often referred as the 'dangling link syndrome'. Of course, a clever webmaster could maintain all the links on a small server with some hundred documents by himself, but within an Intranet environment there are a few thousand documents to take care of.

Note: all Hyperwave features come with the standard server version in contrast to normal WWW systems which have to be enhanced with a huge amount of scripting.

The most important features of the Hyperwave Information Server (HWIS) are listed below according to version 2.5:

5.1.1 Supported Platforms

The Hyperwave server is available on the following platforms:

Operating System	Hardware Platform
Windows NT	Intel PCs
Digital UNIX V3.2 or above	DEC Alpha
HPUX 9.05 or above	Hewlett Packard HP 700 series
IRIX 5.3 or above	Silicon Graphics Workstations
SunOS 4.1.3	Sun Sparc
Solaris 2.3 or above	Sun Sparc
AIX 4.1	IBM RS/6000
BSDI 2.1	Intel PCs
Linux 2.0.x ELF	Intel PCs

5.1.2 Hyperwave Object Oriented Database

Hyperwave uses an **object-oriented database model** both to store all data objects ('HWObjects') and to handle users, user groups and access rights**.** See section 5.2, 'The Hyperwave Class Hierarchy Chart', to gain an overview on the Hyperwave object class hierarchy.

5.1.3 Hyperwave Document Types And Multimedia Support

Hyperwave supports all kinds of **Multimedia document types**, which are needed to create high quality courseware for Web Based Training systems. Amongst others, the important ones are:

5.1.3.1 Text Documents

Text in electronic form has many advantages to the traditional printed form:

- A huge amount of information, e.g. a library, can be stored electronically without consuming a large physical space.
- Electronic text can be easily transferred over wide distances via computer networks
- Hypertext. A special form of an electronic document containing interlinked chunks of self-contained text so that readers are not bound to a particular sequence of text like in old-fashioned printed books.
- Search facility. Hyperwave offers a full-text search option for all text documents stored in the server database.

One of the major disadvantages of electronic text is that you can not read it in certain places, for example in bed or on the restroom (this feature is provided by the good old printed book !). Text can be stored in various document formats:

- **HTML**
  HTML stands for <u>H</u>yper<u>T</u>ext <u>M</u>arkup <u>L</u>anguage. It is a SGML[15]-based format that describes the structure of a web text document, including embedded links to other documents. HTML defines the logical structure of text rather than the layout structure. All the formatting and layout is done by the web browser, depending on actual window size, character settings, screen resolution and so on. Most documents you encounter in the Internet are HTML documents.

- **PostScript** and its successor **PDF**
  PostScript or PDF ('Portable Document Format'), both formats developed by Adobe (http://www.adobe.com), should be used when the layout of a text is important. With Hyperwave you can even have hyperlinks within a PostScript document, thus there is no need to convert existing PostScript files to PDF.

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[15] SGML: ISO Standard Generalized Markup Language

- Documents determined by the **MIME-standard**, e.g. Microsoft Word documents. The browser detects the MIME[16] type and then automatically fires up the proper application at the client side.

- **ISO Plain Text**
  Standard ASCII text files without any special layout or logical structure information can be used in some cases, too.

5.1.3.2 Graphics and Images

Pictures and Graphics can be used to illustrate and enrich HTML text documents. Say, for a web based course on electronics it would be a great idea to put in pictures and sketches of a transistor instead of a text-only description. Digital Images consume a large amount of memory when they are stored without data compression technique, thus there are a number of digital encoding formats used in order to reduce transmission times and file size on the server. The common image file formats of the World Wide Web can be found here:

➢ **GIF**
  GIF stands for Graphics Interchange Format. It has been developed by CompuServe for online applications. It uses a LZW compression algorithm patented by Unisys (There is a CompuServe license agreement with Unisys, December 1994). Thus, there is a patent problem for software developers: Unisys will not pursue legal action against pre-1995 software but as of 1995, developers of commercial software containing LZW must purchase a licence. Nevertheless, GIF is a widespread image file format.

➢ **JPEG**
  JPEG is the short form for Joint Photographic Experts Group (a joint ISO/CCITT committee). In general, the JPEG standard specifies a family of compression algorithms. See Gregory Wallace, 'The JPEG Still Picture Compression Standard'. Communications of the ACM, April 1991 (ftp://ftp.uu.net/graphics/jpeg/wallace.ps.gz). JPEG has a very high data compression rate and it outperforms GIF. Thus, I recommend to use JPEG for high quality pictures in Internet/Intranet applications.

➢ **PNG**
  Portable Network Graphics. This graphics format has been developed in 1995 by the Internet community in response to the GIF LZW patent problems. PNG performs well, but it is not widely deployed yet.

5.1.3.3 Audio Documents

Another important category of multimedia document types are audio files. Like with text or image documents it depends on the type of audio data you want to store: Synthesiser music, human speech or digitised music in hi-fi stereo quality. In most cases good quality audio files consume a large space of memory and bandwidth. The reason for that is the high sampling frequency and analogue to digital bit resolution needed to gain the same quality a

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[16] MIME: Multipurpose Internet Mail Extension

standard audio compact disc has. Consider recording a stereo sound file at a sampling rate of 44.100 Hertz and a resolution of 16 bits per audio channel: This means you have to handle 176.400 Bytes of digital audio data each second ! (44.100 Hertz sample rate means you get a digital sample of two bytes 44.100 times a second, for each audio channel, this sums up to the gigantic number of 176.400). Simple audio file formats store this gigantic data stream without any data compression or reduction algorithm. Recently, very sophisticated algorithms have been developed to compress audio files at a ratio of 10:1.

Very important for Internet/Intranet applications like web based training systems is the capability to perform data 'streaming'. This means, you do not have to wait until the whole audio (or even video) file is downloaded from the server. With a special plug-in application installed on the web browser at the client side digital audio data can be transferred, decoded and passed to the sound device in real time. You can imagine such an application like turning on your good old tuner and selecting a channel to listen news or music, on the Internet you have to select an URL rather than a frequency. This 'streaming' technology has been introduced first be RealNetworks Inc., a company working on the area of digital internet pointcasting.

➢ **MIDI**

MIDI stands for Musical Instruments Digital Interface. It is a standard for digital communication between synthesisers and computers. With MIDI computers can control synthesisers and play music. MIDI does not digitise sonic waves, thus MIDI files are not very large and therefore easy to handle over networks.

➢ **AU, WAV**

AU and WAV are examples for somewhat 'dumb' file formats for digitised audio data. These formats do not use sophisticated algorithms to reduce the amount of memory, they really store the whole 'raw' digitised audio data. As an example, hard disc recording of a normal four minute stereo song with WAV results in file with a size larger than about 40 Megabytes !

➢ **MPEG Layer 3**

MPEG Layer 3 is one of the best algorithms available to reduce the amount of audio data yet preserving the same quality. I strongly recommend to convert all your WAV or AU files to a format like this, because the compression ratio of MPEG Layer 3 can be good as 10:1, thus reducing the 40 Megabyte file 'monster' mentioned above to a handy 4 Megabyte one, and the human ear is not able to sense a quality difference.

➢ **RealAudio**[17])

RealAudio is another format which uses smart compression algorithms. Furthermore, RealAudio supports data streaming and thus is becoming very popular in the Internet. RealNetworks, creator of RealAudio, offers an encoder for free over the Internet, so every user is able to convert his WAV or AU files into streamable RealMedia files.

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[17] RealAudio is a product of RealNetworks, Inc. See http://www.real.com

5.1.3.4 Digital Video

In teaching scenarios videos play an important role. The best way to understand something is actually to watch it. Another approach is to digitally record whole lectures and put it into an electronic library, so that students are able to attend a course whenever they want. Theoretically, this sounds to be a great idea to produce high quality courseware, but practically there are a few bitter pills to swallow:

- Digital Videos consume a very large space of memory, thus sophisticated compression algorithms have to be applied.

- In many cases network bandwidth needed to transport digital videos to the end user is still a problem.

The Moving Pictures Expert Group (MPEG) has developed a few standards to solve these problems:

- **MPEG**
  MPEG stands for Moving Pictures Expert Group, like JPEG it is a standard that defines compression techniques for synchronised digital video and audio. There are a few MPEG definitions:

  - MPEG-1: Bit stream optimised for a data bandwidth around 1.5 Mega bit per second with a resolution of 352 x 240 pixels at 30 Hertz (e.g. for CD-ROMs, DAT and hard-disc)

  - MPEG-2: Targeted at broadcast TV quality with 752 x 480 pixels and 30 Hertz for a bandwidth of 4 to 9 Mega bit per second. Furthermore MPEG-2 can be used for HDTV (High Definition TeleVision) at a bandwidth of 60 Mega bit per second.

  - MPEG-3: 1920 x 1080, 30 Hertz, 20-40 Mega bit per second (HDTV; now incorporated within MPEG-2).

  - MPEG-4: Used at very low bit rates. 176 x 144, 4-64 Kilo bit per second, suitable for Video phones over standard ISDN lines.

In my opinion MPEG is a very good solution for digital videos stored on CD-ROM or hard disc. Thus MPEG should be used in Computer Based Training (CBT) scenarios. For Internet/Intranet applications you should always consider a digital video format which allows data streaming (this term was mentioned above in the Digital Audio section). This has the advantage, that the user does not need to wait until the whole digital video has been downloaded (which could last quite a while). The quality of such a digital video stream depends on the available bandwidth, though. This means, using a 28.8 KBps modem, data streaming will deliver you a picture quality at the size of a stamp (at a rate of about 5-10 pictures per second) and the sound quality of an old transistor radio. Hence, the only

alternative would be to use broadband network technology in order to consume good quality digital video via the Internet.

➢ **RealVideo, VIVO**

RealVideo by Realnetworks (http://www.real.com) and VIVO are examples for streamable digital video formats suited for Internet applications.

5.1.3.5 Virtual Reality

Virtual Reality defines objects, areas and landscapes existing only within a computer's database or memory. Users with special hardware (e.g. data gloves, data suits and head-up displays) can directly manipulate things or communicate with others in such a virtual world. In its simplest form, you do not need special equipment to step into the virtual world. All the objects are displayed in perspective 3D graphics on the user's computer screen. A popular Internet application of virtual realities are so called '*Avatars*', a sophisticated chat arena, where people can virtually meet and come together in virtual countries and cities.

VRML is an approach how to model and design such worlds:

➢ **VRML**
VRML stands for <u>V</u>irtual <u>R</u>eality <u>M</u>arkup (or <u>M</u>odelling) <u>L</u>anguage. With VRML you can perform and define actions like the following (amongst others):

- Definition of coordinate spaces
- Simple shapes: Cubes, Spheres, Cones, Cylinders
- Transformations: Translation, Rotation, Scale, Matrix transformation
- Cameras: definition of user's initial viewpoint
- Definition of light sources and types
- WWW-Anchors for 'teleporting' through the virtual worlds

5.1.3.6 Hyperwave Server Programming

Additional to the built-in functionality of the Hyperwave server various applications can be programmed with common Internet languages like Java or JavaScript. Together with the PLACE programming language offered by the Hyperwave Wavemaster gateway this is a powerful combination in order to create Internet/Intranet applications like web based training systems. *Clientside* programs have to be downloaded from the server to the client and executed within the user's web browser. *Serverside* programs are in general CGI scripts that perform an action directly on the server's machine.

Clientside Programming

➢ **Java**

Java is an object-based programming language, similar to C++, developed by Sun Microsystems especially for the Internet. Java is platform independent and a good approach to implement things that you can not perform with a standard web browser. For example, the 'Treeview' and 'Local Map' utilities that come with the Hyperwave Information server are written in Java. Synchronous discussion forums (chat) needed for web based training systems are implemented with Java, too.

➢ **JavaScript**

JavaScript has less in common with Java as you might expect from it's name. It is a script-like object based programming language. JavaScript source code directly resides in HTML pages and can perform certain important actions, like controlling some features of the web browser. JavaScript allows to make dynamic content out of otherwise static HTML documents, e.g. JavaScript can provide a proper user interface to control all features of an application. For example, the whole user interface for the GENTLE web based training system is written in JavaScript working together with PLACETemplates.

Serverside Programming

➢ **CGI Programs**

The Common Gateway Interface (CGI) is used to perform actions directly on the server's machine. Although every programming language (eg. C or C++) could be used, it is recommended to take a scripting language like Perl for that job. Perl is an interpreted computer language without long compilation times, thus allowing fast testing and debugging of applications. Perl[18] is one of the most commonly used scripting languages and it is available on many platforms including UNIX, MS-DOS, Windows NT and Macintosh Operating Systems. Perl provides sophisticated string matching and text file processing facilities which make it perfect as Hyperwave scripting language. Another advantage of Perl is that its syntax is very similar to C and therefore easy to learn for anyone familiar with C or C++. As an example, Perl scripts are used in the GENTLE system by the Course Wizard, an authoring tool needed to create brand new courses. These scripts are able to insert, delete or modify documents within the Hyperwave database or even create new users and user groups.

➢ **PLACETemplates**

PLACETemplates are a special feature of the Hyperwave Server to design and control the WWW gateway 'Wavemaster'. Using PLACE it is possible to embed all Hyperwave standard features like search, identification and document annotation in all kinds of documents. Together with JavaScript you can create powerful network applications with just a few lines of source code. Example: Large parts of the

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[18] Perl: Practical Extraction and Report Language

asynchronous discussion forum of the GENTLE system have been implemented with PLACE.

5.1.3.7 Hyperwave Data Hierarchy

- Documents are stored in **Collections** and it's sub classes like **Clusters**, **MultiClusters**, **Sequences** or **Alternative Clusters**.

  1. **Collections**...

     ...contain Hyperwave objects (text, graphics, etc..) or other collections. Think of Collections as being analogous to a file system with directories that contain files as well as other directories. To the right you see a typical hierarchy of all kinds of Hyperwave Collections.
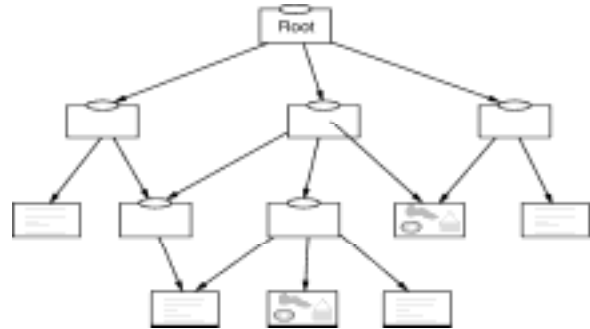
  2. **Clusters**...

     ... (a subtype of Collections) are used to contain multiple documents, too, but they have certain abilities to display documents according to user preferences.

  3. **MultiClusters**...

     ... simultaneously display all the documents they contain.

  4. **Sequences**...

     ... are useful e.g. for 'slide shows'. Objects stored in a sequence are displayed along with arrow icons which can be used to page back and forth sequentially through the contents of the collection.

  5. **AlternativeClusters**...

     ... allow a choice between objects of the same type but with different levels of quality. With AlternativeClusters, it is possible for users to receive their preferred document types.

figure 5-1 : Collections can contain documents or other Collections. Clusters are used for automatically displaying certain objects belonging to the Cluster. Sequences can be used for 'slide shows', the objects are displayed along with forward and backward buttons.
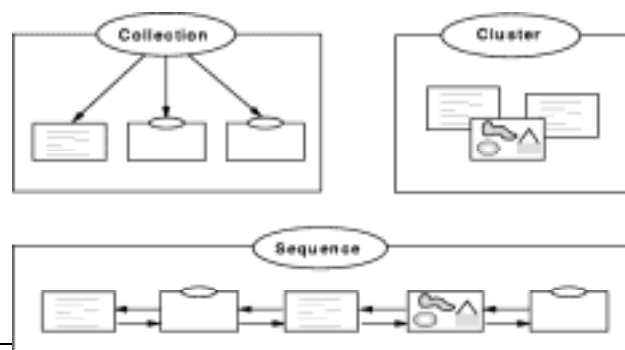
5.1.4 Link Management

- **Hyperlinks** are <u>not</u> part of the document. They are stored in a separate link database. These links are typed and bi-directional. Thus, the user can follow a link forward and - in contrary to a normal WWW server - backwards. The link database maintained by the Hyperwave server is one of the major differences between Hyperwave and typical web servers. As a result, you will never find links to nowhere ('dangling links') within the Hyperwave server. When a document is deleted, the Hyperwave server is smart enough to erase all links pointing to it as well. Furthermore, the native Hyperwave clients can generate link maps for each document showing all source and destination pointers (this map is called the 'local map' in Harmony, the native Hyperwave client for Unix machines).

- **Anchors** can be attached to
    1. Text
    2. Parts of images
    3. Regions in a film clip
    4. Regions in 3D scenes

Due to the use of a separate link database it can be guaranteed by the system, that there are no 'dangling' links within documents of the document database. Documents can be inserted and deleted without any link adjustment in related documents. Furthermore, this enables users to annotate even documents which do not belong to them.

5.1.5 User Groups

- **Users, User Groups and Access Rights**
  Hyperwave has a system of access rights which can be used to grant or restrict various types of rights for collection and document access. It is possible to assign access rights to every kind of Hyperwave Object. With a proper authorisation scheme different user groups can work on the same server (e.g. in an Intranet) without interfering each others data.

There are three different types of rights:

1. *READ* **rights**
   The right to view information.
2. *EDIT* **rights**
   The right to create, alter and edit information
3. *UNLINK* **rights**
   The right to delete documents from a collection.

5.1.6 Document Attributes

- **Metainformation** ('Attributes') can be used for each document to satisfy the following requirements of a modern system:

  1. Various kinds of access permissions (e.g. read and write access control)
  2. Support of language attributes for each document
  3. Support of a billing mechanism
  4. Multiple document versions (e.g. documents for novice and advanced users; in the GENTLE system there are different documents according to the three learning styles 'verbal', 'symbolic' and 'visual'.)

5.1.7 Search Facility

- Sophisticated **full-text search facilities** are provided by the Hyperwave server. The search scope can be set by the user, even if the collections to be searched reside on different servers. The meta information mentioned above can be included in the search. The user can decide to search the server by an object title or by some document attribute. Keywords (each document can be enhanced with a Keyword meta information which helps to describe an object) are very useful when performing a search action. Furthermore you can search in the actual text of text documents, search by author or time the document was last changed. All of these attributes are indexed on the server allowing a very fast search.

5.1.8 Miscellaneous Features

- **Annotations**
  Annotations with user-definable access rights are supported as a result of the separate link database. Annotations can themselves be annotated, which is a starting point to create online discussion forums like in GENTLE.

- **Distributed databases**
  Hyperwave servers can be grouped into 'tribes' that act as one logical system.

- **Local Map and Treeview**
  The 'Local Map' and 'Treeview' are Java applications to display the current database structure graphically. These applications are provided to avoid the 'lost in hyperspace' syndrome.

- **Customisable WWW user interface (the 'Wavemaster')**
  When accessing the Hyperwave Information server through a standard web browser (say Micrsoft InternetExplorer or Netscape Communicator) the Wavemaster (an internal module of the Hyperwave server) is responsible to provide the user interface for important Hyperwave functions like annotation or search. The WWW user interface for

all the Hyperwave functions (e.g. search and identify) can be re-defined by using so-called PLACETemplates, which contain all the interface properties and styles. Together with JavaScript powerful user interfaces can be created for almost every application.

5.1.9 Authoring

- Native **Hyperwave Clients**
  When it is up to authoring and administrating large amounts of data, the native Hyperwave Clients come into play. The native clients grant more tools and authoring capabilities than the Wavemaster interface does.
  Hyperwave (native) Clients:

  ➢ **Harmony** – the native Hyperwave client for Unix platforms

  ➢ **Amadeus** – the native Hyperwave client for Microsoft Windows platforms

5.2 The Hyperwave Class Hierarchy Chart

```
HWObject
   │
   ├──▶ Anchor
   │       ├──▶ DestAnchor
   │       └──▶ SrcAnchor
   │
   ├──▶ Document
   │       ├──▶ Collection
   │       │       ├──▶ Cluster
   │       │       ├──▶ MultiCluster
   │       │       ├──▶ AlternativeCluster
   │       │       └──▶ Sequence
   │       │
   │       ├──▶ GenericDocument
   │       ├──▶ ImageDocument
   │       ├──▶ MovieDocument
   │       ├──▶ PostScriptDocument
   │       ├──▶ RemoteDocument
   │       │       ├──▶ FTPDocument
   │       │       ├──▶ GopherDocument
   │       │       ├──▶ SQLDocument
   │       │       └──▶ TelnetDocument
   │       │
   │       ├──▶ CGIDocument
   │       ├──▶ SceneDocument
   │       ├──▶ SoundDocument
   │       └──▶ TextDocument
   │
   ├──▶ Group
   ├──▶ Server
   └──▶ User
```
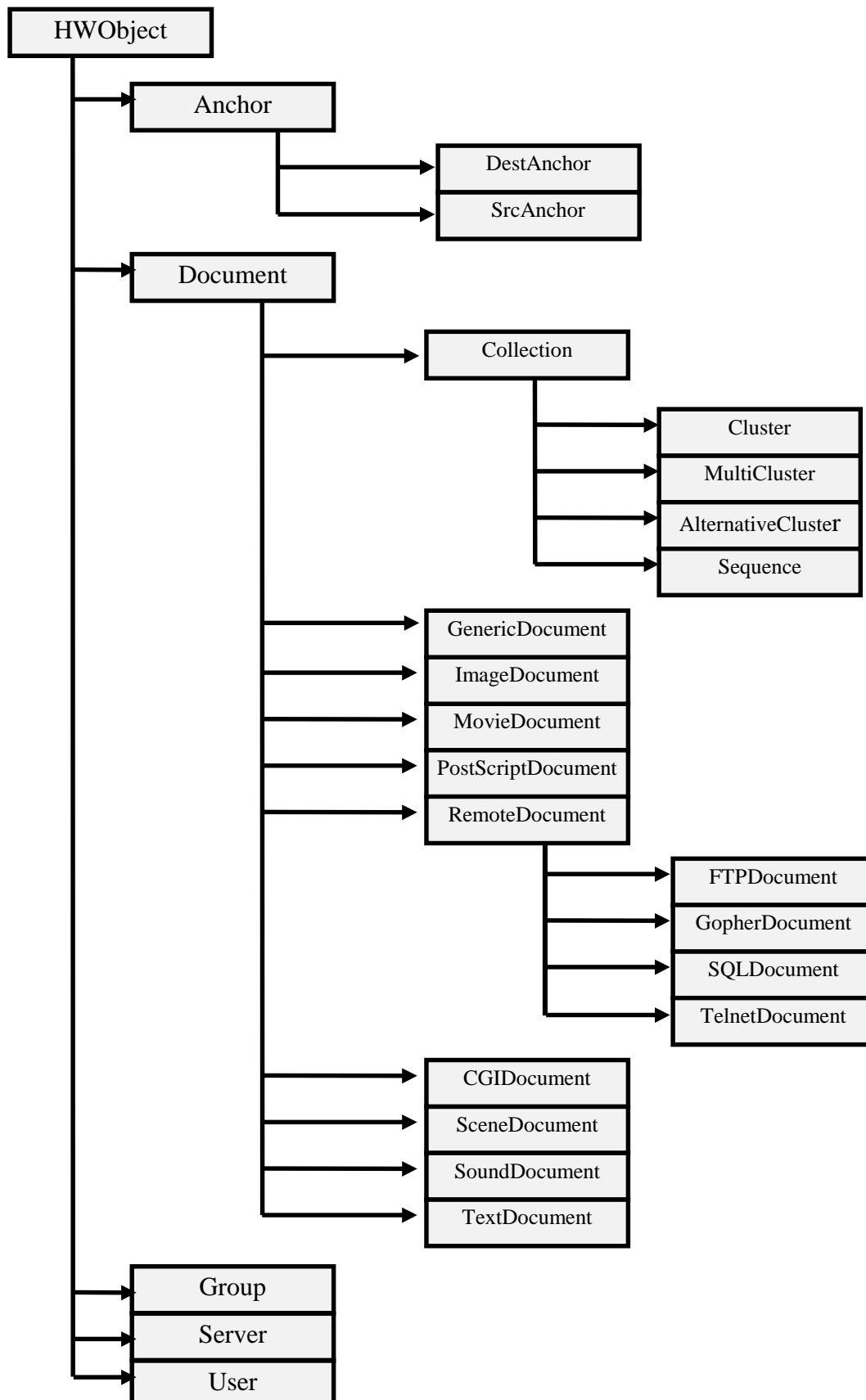
5.3 Other Facts About Hyperwave

Last, but not least it should be mentioned, that Hyperwave is an award winning product:

- **The European IT Prize**

  In 1997, Hyperwave was amongst the European IT Prize Grand Prize winners.
  (See also http://www.it-prize.org)

  'The leading Information Management System for public and corporate Web Sites.'

- **CeBIT '97: Byte Magazine's 'Best of Show Award'**

  (See also http://www.byte.com/special/cebit97.htm)

  To your right hand you can see Austria's prime minister Mag.Viktor Klima having a visit at Hyperwave and its founder, Prof. Hermann Maurer (on the left).

5.4 The Scientific Evolution Of Hyperwave WBT Systems

Like in real life, there is an Evolution (in the sense of science and research) of Hyperwave-based education systems. The ideas and concepts for these evolutionary steps can be found in various scientific papers by Hermann Maurer and Thomas Dietinger. This section gives you a GENTLE 'gallery of ancestral portraits'. First, there was

5.5 LATE

The **LATE** ('Learning And Teaching Environment') concept has been published by Maurer in the Journal of Universal Computer Science (J.UCS) in 1996. [Maurer 1996b] LATE is a concept that pulls together a number of developments in an uniquely integrated way to provide - for the first time in the history of computing - an approach to computer assisted learning and teaching that offers a realistic alternative to more traditional methods.

5.5.1 General Outlines of the LATE concept

Late is based on years of experience with the use of computers in educational settings, it takes advantage of research results with

- **Hypermedia Card (HM-Card)**, one of the most advanced 'authoring and CAI' systems available [Maurer/Sherbakov 1996]
- **Hyper-G** [Kappe 1993] / The first second generation WWW server system [Maurer 1996a]

LATE is concerned with a number of disciplines, amongst others

- Computer Aided Instruction (CAI)
- Authoring Systems
- Hypermedia Systems
- WWW server systems
- Computer Supported Collaborative Work (see chapter 4, Computer Supported Collaborative Work (CSCW), page 43)
- Digital Libraries [Marchionini/Maurer 1995]

5.5.1.1 The CAI nucleus of LATE

The CAI nucleus of LATE is basically WWW enriched by the features of HM-Card and other document types available in the Internet, which require helper applications[19] for viewing. Adobe's Portable Document Format[20] is just an example for a high quality text document type. Thus, LATE allows the creation of high quality multimedia courseware.

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[19] 'plug-ins' or 'add-ons' for common WWW browsers like Netscape Navigator or Microsoft Internet Explorer.
[20] Further reading on Adobe's Portable Document Format (PDF): see 'The Portable Document Format Reference Manual', Adobe 1993, Addison-Wesley Publishing.

Properties of LATE-based courseware:

- The courseware is embedded in a computer network
- Asynchronous and Synchronous interaction between all participants of a course are supported
- Courseware Modules are part of a large electronic repository

5.5.1.2 LATE: The 'breakthrough' in computer supported teaching and learning becomes feasible

LATE takes an approach on how to be efficient and successful in computer supported teaching and learning scenarios. One should consider the following arguments speaking for the LATE concept:
- Price / performance ratio of equipment is no longer a problem today.
- Techniques for high quality visualisation are now available.
- Efforts to produce quality courseware have been reduced a lot due to better authoring software and the use of media from various sources.
- Decentralisation and yet keeping records of use can be achieved by putting the courseware on World Wide Web servers. (this is a very crucial point in LATE)
- Modularity, maintainability, reusability and customisability (e.g. available in HM-card) assure that LATE allows more efficient authoring by orders of magnitude.
- '*Authoring on the Fly*' may soon be a possibility. See [Ottmann 1995]
- LATE suggests to have as much navigational freedom and cross-references to other material as is desirable for the subject at issue.
- Both guidance and freedom is available[21].
- Stand-alone and networked mode are supported

5.5.1.3 The role of HM-Card

HM-Card is a set of tools that enables authors to build powerful interactive multimedia presentations and courseware. 'Interactive' means, that the system does not just allow the users to choose different paths from time to time, but that fairly complex system-user dialogues can be incorporated. So, HM-Card provides a new paradigm for 'navigating' from one multimedia document to another, both with and without the use of so-called 'hyperlinks'. As in the Hyperwave server system, HM-card includes the feature of 'link-consistency' and to allow a modular approach to the design of presentational packages.

HM-Card can be used in order to solve the following tasks:
- Personal multimedia information systems authoring and management
- Courseware creation
- Integration of other applications
- Presentations/Demonstrations in combination with the World Wide Web

Examples for HM-Card applications can be found at http://www.iicm.edu/mankind.

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[21] In other words: 'we need guidance but not dictatorship !' (Hermann Maurer)

5.6 MANKIND

MANKIND is an acronym for *Multimedia And Networked Knowledge-transfer Introduces New Dimensions.* It is an ambitious undertaking that combines know-how obtained through extensive research and efforts in network based training and education with work on digital libraries and the development of advanced WWW server system Hyperwave (formerly called Hyper-G). Thereafter, the MANKIND concept can be seen as the successor of LATE (see chapter 5.5, LATE, page 66). You should consider that MANKIND is actually not a Teleteaching[22] application. The MANKIND-project has been originated by Professor Hermann Maurer at the Institute for Information processing and Computer supported new Media (IICM), a department at the Graz University of Technology in 1997.

5.6.1 Key Issues For MANKIND

- **Different people have different learning styles**.

Ideally each *Module of Knowledge* should exist in:

1. a *verbal,*
2. a *symbolic*,
3. a *visual* form.

Modules should be delivered based on **individual learning** and retention style.
This gives an idea what the concept of **adaptive course clusters** is about.

- **Different students have different backgrounds**.

  Learning material has to be broken up into very small modules. Intensive pre-tests should be used to determine which modules are useful in which order.

- **The Environment**

  Another crucial factor is the technical equipment available.
  The following points have to be taken into consideration:

  1. Computer hardware and software (e.g. operating systems)
  2. Network access and data bandwidth
  3. Location of Equipment (can the system be used from home or only at the campus ?)
  4. How is the system going to be used by the teacher and students ?

- MANKIND is based on the advanced WWW server system **Hyperwave**.

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[22] Teleteaching : Teaching people in different physical locations using live broadcasts (digital or analogue) and/or „canned" courseware, but at least with email feedback.

- **Different document types** are allowed to be inserted into the course database, this could be

    1. HTML documents,
    2. Audio files,
    3. Video clips,
    4. Pictures,
    5. Animations.

(just to name a few)

- Each student has a **Virtual Working Place (VWP)** in order to attend the web course
- An extensive **Background Library** is provided to the student
- **Annotations** with special attributes

    1. private,
    2. public,
    3. question ...

 to each document are possible. This is one of the central aspects of the web course system.

- Support of a **Discussion Forum** (asynchronous communication).
- Support of **Chat and Whiteboard**[23] (synchronous communication).
- **Statistic Tools** to get feedback on courses from the students. Statistic information on a course can be used by the teacher to improve his lecture style and methods.
- A combined **Online / Offline version.** Huge amounts of data should reside on a CD-ROM, discussion results and annotations are synchronised when the connection to the course server is made.

In Summary, what we have is a system where:

    ✓ Courseware is built rapidly and with high quality
    ✓ Students can peruse it at their own speed
    ✓ Students can browse in background libraries
    ✓ Students can add notes
    ✓ Students can participate in discussions and voting
    ✓ Students can ask questions to fellow learners or tutors
    ✓ Students can increase the knowledge in the database
    ✓ Students provide important feedback

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[23] Whiteboard: A form of synchronous communication not only using text but also an area (called the 'Whiteboard') for drawing sketches and images visible to all participants.

5.6.2 The Ten Theses (Guidelines) for MANKIND

Ten general thesis (guidelines) that must be kept in mind when designing or evaluating an integrated teaching and learning environment are described in this section. Some of them have already been analysed in more detail in LATE (see chapter 5.5, LATE, page 66). The ten theses (conceived by Maurer) present also the basic guidelines for the MANKIND project. [⌨ Maurer 1997]

5.6.2.1 Thesis 1: 'No matter what technology is used, insights obtained for traditional courseware design both from a pedagogical and content/form point of view must not be ignored.'

'It is a crucial error to believe that linking a few HTML pages together produces viable material for Computer Aided Learning (CAL) purposes'.

1. State aims and prerequisites clearly
2. Use well motivated material
3. Use features like fonts, colour, graphics, animation not as gadgetry
4. Student interaction should be higher than 'electronic page turning'

5.6.2.2 Thesis 2: 'The production of high-quality courseware has to be made as easy as possible.'

In a system like MANKIND this means basically five things:

1. The system has to be open to let authors choose their preferred tools[24].
2. Techniques such as '*authoring on the fly*[25]' have to be supported.
3. Software must include simulation and interactive techniques.
4. Statistical information and feedback from students has to be provided by the system for the improvement of materials.
5. Courseware has to be designed in a modular way so that it is easy to update and reuse.

Ordinary WWW server systems, where all the structure is built into links cannot be seen as serious candidate for sophisticated MANKIND-like systems. Therefore, a more powerful environment such as Hyperwave is needed to structure the courseware material into modules (called 'Collections' in Hyperwave, see [📖 Hyperwave 1997b] for more details on data structures available in the Hyperwave environment) that can be reused and updated without the need to change any links to and from them. Another approach is the HM-Data model.

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[24] e.g. Netscape Communicator's Page Composer or Microsoft Frontpage for HTML editing and Corel Draw! for graphics design, just to name an example.

[25] A term first coined by Maurer and successfully pursued by the group of Thomas Ottman at Freiburg

5.6.2.3 Thesis 3: 'We need guidance but not dictatorship.'

How to avoid the so-called 'tunnel-syndrome' of early CAI systems ?

1. Provide a certain amount of guidance through the courseware material
2. The user should be always able to decide where to continue
3. The user should be able to consult an electronic library residing in the background.

The Electronic Background Library

A basic electronic background library can contain the following items:

- Small collection of dictionaries
- Electronic books
- Supporting multimedia material
- Software repositories

The library can be enhanced to a very large electronic archive covering all kinds of knowledge.

To work efficiently with an electronic library consider the following aspects:

1. Structure the knowledge
2. Define 'search scopes' depending on the student's personal profile
3. Avoid information overkill
4. Take advantage of WWW systems with built-in databases

5.6.2.4 Thesis 4: 'Facilities for annotations are essential.'

Students should have the possibility to add personal or public notes to:

1. Courseware
2. Electronic books
3. Pictures
4. Arbitrary documents
5. Hyperlinks to other material

Note: Hyperwave already offers an annotation facility.

5.6.2.5 Thesis 5: 'Facilities for asynchronous computer conferencing are imperative.'

A step beyond the annotation facility leads us to asynchronous discussion forums or computer conferences. In a simple version the discussion forum behaves like a Usenet newsgroup or a bulletin board. A better structure is preferable to follow a discussion thread, anyway. Comments and annotations should be categorised and visually displayed with icons in the following way:

- Supporting Example
- Counter Example
- Supporting Argument
- Counter Argument
- Generalisation
- Special Case
- Answer
- Related Idea

Newscasting

In order to be up-to-date with current discussions the discussion forum can be combined with an electronic mail system. The minimal solution is to inform participants of a discussion forum by Email that new contributions have been added to the forum.

5.6.2.6 Thesis 6: 'Question / Answer dialogues should be possible where users need them.'

Beside the asynchronous communication facilities there should be so-called '*electronic office hours*', where students can talk online with the teacher.

5.6.2.7 Thesis 7: 'An integrated teaching and learning environment needs synchronous communication facilities.'

Chat

Online, synchronous communication with other students in so-called 'chat rooms'.

The Whiteboard

The Whiteboard is a shared electronic workspace that allows online interaction with other users. For example, it is useful in co-operative work for explanatory purposes. The tutor draws a sketch on the whiteboard allowing all connected students to comment on it.

5.6.2.8 Thesis 8: 'Question/Answer dialogues should become part of the multimedia database.'

Typically, if a student asks a specific question and a tutor answers it, this question/answer pair should be recorded so that when other students ask a similar question later the system automatically can present the answer that might well have been given months ago.

5.6.2.9 Thesis 9: 'Testing and checkpoints are important'

- '**Profiler**'. This is a pre-test to examine the student's knowledge, needed to select the proper set of 'teaching modules' in the right order.
- **Self-testing.** Students should be supported by self-tests to determine if they have understood a course lesson correctly.
- **Exercises**. After theoretic lessons there should be some practical exercises.
- **Voting and 'anonymous discussions' (Decision Room Scenarios)**
  Anonymity is an important aspect while brainstorming or decision making. Without it participants of a discussion fear to voice unpopular opinions. Different levels of anonymity are described in [Flinn 1995].

5.6.2.10 Thesis 10: 'MANKIND cannot live without customisation'

The system should be intelligent enough to examine one student's learning habits and thus fit her/his needs best by selecting the appropriate course module for the student.

5.7 GENTLE

The current evolutionary stage of Hyperwave based training systems is called GENTLE, an acronym for General Networked Teaching and Learning Environments. This term was first coined by Professor Skordalakis from the National Technical University Athens. The concept of GENTLE is firmly based on the 'Ten Theses' mentioned in the MANKIND-section. In general, GENTLE inherits all the concepts of both LATE and MANKIND. Further information about GENTLE can be found in [Dietinger/Maurer 1997].

6 The Technological Requirements for GENTLE

In this section I will describe and illustrate the technological requirements for computer and Web Based Training systems with a special focus on GENTLE, which is based on the premise that computer networks with reasonable bandwidth are the basis of non-isolating powerful teaching, training and learning environments.

The reader should keep always in mind, that Web Based Training is a network application taking advantage of the concepts and components shown here. Therefore, it is quite useful to know the basic computer and network characteristics (for example data bandwidth, which is the crucial aspect in multimedia and hypermedia network applications).

6.1 Network Access to GENTLE

Information networks have become very important to us nowadays. Amongst others, the Internet and especially the World Wide Web are the main arenas for global interaction, electronic publishing and communication. It is a world-wide computer network, often called '*the Net of the nets*'. Our Web Based Training system, GENTLE, is conceived for the use in the WWW. This gives the advantage, that students can attend courses virtually from almost any place in the world, though the education server is located at the IICM, a department of the Graz University of Technology. Furthermore platform independence is guaranteed due to Internet standards like HTML for documents and Java/JavaScript for applications running within the web browser on the client side. Some may say that Netscape's Navigator/Communicator is the best browser available, others tend to use Microsoft's Internet Explorer. In fact, there's a little struggle going on between these two groups. In my opinion, for using GENTLE it doesn't really matter which of them are used, anyway. Sadly, there are still many problems concerning the data bandwidth in some sub-parts of the Internet. You can imagine the Internet like a public road system. There are a few high speed data connections (like freeways, but as you know, during the rush-hour it is impossible to move on fast when all available lanes are congested with thousands and thousands of cars heading to work in the morning hours or vice versa heading home at the evening, sigh!) and a lot of very slow ones (like country roads, when some farmer blocks the way with his tractor). We said, that good quality courseware demands for all kinds of Multimedia documents (say colour images, audio and video clips) thus resulting in very large amounts of data to be transferred to the student. In order to get the best courseware quality to the student we need broadband networks for GENTLE, there is no way around. Of course, options can be set to reduce the amount of data when narrow-band network connections like slow 28.8 kbps modems are the only alternative, but the courseware quality will suffer then.

In general, when conceiving network based applications, one should know the 'quality' of the data connections to the customers, in our case the GENTLE-students. Therefore, I will give you a 'roadmap' in terms of network connections describing the ways you can access the GENTLE-WBT server located on a Windows NT HyperWave server at the IICM. In the next section we will have a closer look at the Graz University Data Network (UDN), a broadband data network suitable for GENTLE.

6.2 The Graz Virtual University Campus

Introduction

GENTLE has been used to hold virtual lectures here at the Graz University of Technology . I have to mention, that the whole system is in an early stage when this text was written. GENTLE-project leader Thomas Dietinger and the other GENTLE-staff members are currently preparing the courseware material for a lecture called 'Multimedia Information Systems'. Thomas is holding some parts of this lecture in the traditional way in the lecture hall, other parts of it by using GENTLE.

Student Access To GENTLE

How many people can be reached theoretically with GENTLE ?

In order to give an answer to that question, we must have a closer look on the so-called '**Virtual University Campus**':

The Austrian Department of Science launched an initiative to extend the Graz University of Technology virtually via a computer network. The existing University Data Network which connects all three universities here in Graz has been modified with fibre optics and ATM technology and furthermore all student hostels and a number of public schools have been attached to it with ATM switches resulting in a very high bandwidth available between all of them (exactly, it is an OC-3/155 Mega bit per second data rate). Thus, within the UDN broadband network applications like GENTLE can be used by lots of students without loss of courseware quality. Students can attend GENTLE-courses using their private workstations in their apartments in the student hostels or in the computer rooms located at a university or university department in Graz with the same network quality in terms of bandwidth, that is at least 10 Megabits per second.
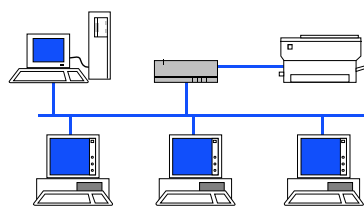
6.2.1 GENTLE and the University Data Network

The 'Roadmap' to GENTLE, located at the IICM (standing April '97):
(source: DI Haselbacher, Central Informatics Service, TU-Graz)

UDN-Graz

Student Hostels

Karl Franzens University (KFU Graz)

GENTLE installed on a Windows NT HyperWave webserver.

IICM

Univ.of Music & Dramatic Arts (MHSG)

Graz University of Technology (TU-Graz)

UDN-Graz

ATM-Switch

ACONET Node

ASN Node

ACONET customers

Schools with 64 Kbps

PTA-Graz

ATM-Switch

Joanneum Research

WIFI-IIC

GRAX Node

Schools with 2 Mbps

National and international ATM-connections

GRAX - customers

Description of the nodes on the 'roadmap':

UDN components (Graz University Campus Network):

- **Graz University of Technology** (TU-Graz, Technische Universität Graz)
  Web: http://www.tu-graz.ac.at
  About 10.000 students are enrolled at the TU-Graz.
  Home of GENTLE. The GENTLE Web Based Training server is located at the IICM.
  The URL to access GENTLE is http://wbt.iicm.edu

- **Karl Franzens University** (KF-UNI Graz)
  Web: http://www.kfunigraz.ac.at
  The main university in Graz with about 30.000 students enrolled.

- **University of Music and Dramatic Arts (MHSG, Musikhochschule Graz)**
  Web: http://www.mhsg.ac.at

- **Student Hostels**

Further network components at Graz:

- **ASN Node** (Austrian School Network)
  Some high schools in Graz are connected with the UDN via the ASN node with a data rate of 64 kbps each.

- **ACOnet** (Austrian Scientific Computer Network)
  Gateway to academic and scientific networks.

- **GRAX** (Graz Telekis Exchange)
  Node for various Internet customers and providers.

- **WIFI-IIC** (Wirtschaftsförderungs Institut - Interactive Computer Center)
  Training centre supported by the Austrian economy and business council.

- **PTA** (Post & Telecom Austria AG)
  The PTA is responsible for all WAN data traffic in Austria.

6.2.1.1 GENTLE and the Student Hostels

The Student Hostels, which are now being fully integrated into the University Data Network, are playing an important role within the Virtual Campus. Within a few years all Hostels are connected to the UDN. This is shown by the following table:

Student Hostel	Schedule	Network Connections
Münzgrabenstraße 59	Fall '96	58
Moserhofgasse 34-36	Dec. '96	157
Moserhofgasse 20-22	Oct. '97	284
Ghegagasse 9-19	Oct. '97	310
Hafnerriegel 53	Apr. '97	380
Schubertstraße 2-4	Oct.'97	145
Lindweg 33, SALVATOR Kolleg	Oct.'97	80
Babenberg, Schießstattgasse 3	Oct.'97	30
Elisabethstraße 85, Friedrich Schiller Studentenheim	1998	290
Untere Schönbrunngasse 7-11	1998	230
Elisabethstraße 93	1998	310
Wienerstraße 58a	Feb. '98	250
Leechgasse 24 / Afro-Asiat./Elisabethstr.45/Straßoldg. 4+6	1998	164
Billrothgasse 41-43	1998/99	74
WIST-OÖ, Fröbelgasse 34	1998	70
Am Rehrgrund 14	1998/99	124
Am Rehrgrund 4	1998/99	100
Grüne Gasse	1998/99	34
Elisabethinergasse 21	1999	43
Kolpinghaus, Conrad v. Hötzendorfstraße	1999	300
Liebiggasse 4	1998	200
		3633

(source: Dr.Theurl, vice rector for planning, development and resources at the TU-Graz)

This sums up to more than 3.600 networked working places for students with a high speed data rate of at least 10 Mega bits per second. Around the year 2000 there will be about 4000 network connections available to the students here at Graz. This figure is about 10 percent of all enrolled students, the next step is to use advanced technologies like ISDN and ADSL (described later) to reach the other 90 percent at their private homes. According to vice rector Theurl it will last another ten years until almost everyone will have a data connection to university with at least five Mega bit per second in both directions (symmetric).

Benefits

It would cost about hundred times more to build these computer facilities at the university campus. Furthermore, some thousand square metres for the proper buildings would be required. The 'Virtual Campus' makes it possible that students can work with equal data bandwidth with their own computer equipment from their hostels at reasonable costs.

6.2.1.2 GENTLE and ATM (Asynchronous Transfer Mode)

Broadband Networks For Multimedia Content

GENTLE and broadband networks - one can not live happily without the other. In this part you get a basic introduction to the technology used within the UDN. Using GENTLE within the UDN, a high data transmission rate is provided by Asynchronous Transfer Mode (ATM), an advanced networking technology.

Short Description: ATM

What is ATM ? Most broadband network 'gurus' get excited when they are talking about ATM and its various features. ATM can accommodate various type of digital data traffic. Therefore, for seamless integration to support multiple QoS[26] - needed for multiple types of services - over any physical medium, ATM may be inevitable.
ATM is capable of providing switched access like POTS (Plain Old Telephone Services) to end users. It uses small fixed-size (53 byte) cells, and therefore guarantee bounded delay and support varieties of services with guaranteed QoS for each of them. It also allows utilisation of the sophisticated billing, maintenance, and operations support infrastructure POTS currently has. Virtual LAN[27] (V-LAN) or the ATM's forum LAN emulation (LANE) standards can be used for providing switched local access to cable modem users. At home, the cable modems must contain ATM network interface cards for converting the data packets to ATM cells in order to send them through the network as per a service/usage contract to the ATM switch at the cable network's head-end. Consequently, access to broadband services like real-time video, high speed Internet surfing and so on can be achieved at 25 MBps or higher speeds. Finally, with proper buffering and timer tuning, both TCP/IP and CSMA/CD services can be supported over ATM as well. The IEEE 802.14 committee is therefore considering both ATM and TCP/IP friendly media access protocols for cable modems.
ATM has the important capability to carry digital information virtually over any network (twisted pair, fiber, wireless) with pre-specified and variable QoS over the same channel or connection. Thus it creates new markets for content providers, and customers can pay on the basis of usage and the QoS they receive from a connection. Thereafter, ATM is the preferred technology of choice, although it has not been widely deployed yet.

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[26] QoS: quality of service
[27] See http://www.data.com for further details

6.2.1.3 GENTLE and Dial up Connections

Another possibility to access GENTLE is by using dial up connections to the Internet. All you need is an Internet provider (in our case it is the Central Informatics Service at the Graz University of Technology) and a fast modem (at least 28.800 bits per second). Unless you are using a call back option and let someone else pay for the connection over the phone wire you must take this into consideration when using GENTLE for a long time via the Austrian phone service. As mentioned before, the courseware quality will suffer due to the very slow data link. Although the data bandwidth is not amazingly high (up to 33 kbps with standard systems or up to 56 kbps e.g. by using the 'x2' technology developed by USrobotics[28]), connections to computer networks (e.g. the Internet) can be made with standard analogue telephone lines.

These analogue telephone connections are available almost everywhere (Internet access providers are becoming widespread, too), thus working with the Internet from home has become quite popular. Let's have a look at modem standards and digital communication systems which can be used from home:

The Present:

Today, without direct connection to the UDN, GENTLE users have the possibility to dial up an Internet provider with a modem or via ISDN in order to reach the GENTLE server. Sadly, this is only a slow, narrow-band solution. These people can use

- **V.34 Modems**
  V.34 is a common standard for modems. V.34 modems can carry data up to 33.6 Kbps (the maximum theoretical limit is 40 Kbps) over analogue, twisted pair copper telephone lines.

- **ISDN (Integrated Services Digital Network)**
  ISDN uses digital channels and PCM[29] coding with 64 Kbit/sec (B- (data) channel). Telephone, Facsimile, Computers and LANs can be connected via the Customer ISDN Interface. A standard ISDN connection consists of two B-channels (user plane) á 64 Kbps and one D-channel (control plane) with 16 Kbps. This sums up to a total bandwidth of 144 Kbps available with ISDN. The Central Informatics Service at the Graz University of Technology offers a call-back option for ISDN-users allowing customers to connect for free.

The Future:

Advanced technologies will make it possible to have a broadband network connection even over the plain old copper wires (called the 'local loop' or the 'last copper mile') from the switching centre to home. 'When it comes to telecom networks, the last mile is the first item on the net managers' list of complaints. And there's a simple reason: The copper local

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[28] USrobotics: http://www.usr.com
[29] PCM: Pulse Code Modulation

loops that link user sites to the carrier's backbone are bandwidth bottlenecks.' (from: The Last Mile Is Still The Longest by To Chee Eng and David Greenberg, Data Communications, October 1997,page 75ff)

xDSL

xDSL (Digital Subscriber Line) is a group of emerging DSL modem technologies for supporting megabit-rate traffic transmission over POTS lines. It uses state-of-the-art very large scale integration (VLSI) implementations of adaptive digital filtering techniques, trellis coding to increase channel capacity in the presence of Gauss noise and forward error correction (FEC) in order to provide immunity to impulse noise (called 'jitters' or 'glitches').

The theoretical maximum limit of ADSL (asymmetric DSL, that means each direction of data transmission has its own data rate) therefore becomes stunning 10 Mbps. The digital signal processing (DSP) circuitry performs massive direct and inverse discrete fast-Fourier transform (FFT). Deployment of xDSL modems over POTS lines uses existing point-to-point access networking infrastructure in the sense that no (!) additional wiring is necessary, but it needs proper modems at both ends of the line. Therefore, this technology allows rapid deployment of Broadband-To-The-Home (BTTH) services by the POTS access service providers (ASPs).

- **B-ISDN (Broadband ISDN)**

  ATM[30] will be the proper transmission technology in order to implement B-ISDN.
  The base references for ISDN apply also to B-ISDN.

  The main Features of B-ISDN are:
  - Conferencing / Communication
    Video-conferences in realtime, transmission of huge amounts of digital data, e.g. medical images.
  - High data bandwidth and low response time
  - Announcement Services
    Video and Audio - announcements are possible.
  - Demand Services
    Access to digital libraries and video archives ('video-on-demand')
  - Broadcast Services
    e.g. HDTV[31]-broadcasting

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[30] ATM: asynchronous transfer mode
[31] HDTV: High Definition Television

Summary

As a summary and conclusion, the 'fight' against the existing bottleneck technologies at the last copper mile has begun. Here is an overview what we could expect from the future and alternative last-mile technologies:

Alternative Last-Mile Technologies

	Maximum downstream speed	Maximum upstream speed	Bandwith shared with other users	Maximum distance	Availability	Pros	Cons
Asymmetric DSL	6 Mbps	560 Kbps	No	2 to 4 km	Rollouts could start in 1998	Fast, works with ATM	Unproven, aimed at consumers
Basic-rate ISDN	128 Kbps	128 Kbps	No	2 to 4 km	Widespread	Proven technology, equipment widely available	Relatively low bandwith
Broadband wireless (LMDS)	30 Mbps	30 Mbps	Yes	3 km	Not widespread	Not reliant on existing infrastructure	Frequencies unavailable, immature technology
Cable Modems	10 Mbps	10 Mbps	Yes	No maximum	Not widespread	Proven Technology	Reliability questionable aimed at customers
High-speed DSL	2.3 Mbps	2.3 Mbps	No	3 to 5 km	Not available	N/A	N/A as user service
Very high-speed DSL	52 Mbps	Undefined	No	1 km	Rollouts could start in 1998	Fast, works with ATM	Unproven, aims at customers

DSL = Digital Subscriber Line   LMDS = Local Multipoint Distribution Services   N/A = Not Available
(Source: Data Communications, October 1997, page 76)

Further reading: See [📖 Maguire 1997] for advanced networking technologies.

7 Implementation of GENTLE

GENTLE is implemented within a client-server architecture (Browser based application) using enhanced features provided by the sophisticated and powerful HyperWave server environment. First, there is a short overview about the basic structure of a Web Based Training system and its components.

7.1 Overview: The Basic Structure of a Web Based Training System

Participant Level	Course Browser	Student
	Web Browser (Client)	Virtual Working Place
	e.g. Netscape Navigator	Subscribed courses
Course Provider Level	Course Server	Trainer
	Course Database	Course Generator, Authoring Tools
	Courseware	"Course Wizard"
	Student Database	"Page Wizard"

7.1.1 Participant Level

All requirements for a course participant (student) are defined at the participant level. The course browser and the virtual working place form the user interface for the course participant.

7.1.1.1 Participant User Interface and Course Browser

The course browser is a proper client application for the course server. It is used to connect to the course server in order to download the courseware and to communicate with the trainer or with other course students. For instance, the Netscape Navigator (a wide-spread world wide web browser) could be a proper course browser used within a TCP/IP-based network environment, like the Internet.

The Following important locations are accessed with the course browser :

7.1.1.2 Web Course Welcome Page

The Web Course Welcome Page contains the following items:

- General information on the web course system
- Overview of all available courses (course table)
- Hyperlink to the Web Course Matriculation Form

7.1.1.3 Web Course Matriculation Form

First of all, students have to matriculate in the web course system in order to get a private, virtual working place.

Web course matriculation procedure:

- Student Identification (name and register number)
- Profiler to examine the student's knowledge

7.1.1.4 The Student's User Interface: The Virtual Working Place (VWP)

The Virtual Working Place (VWP or 'Locker') is the private working area for each student. It is a user interface for the student to participate in the course. Furthermore, students are able to enhance their VWPs with individual documents, hyperlinks, annotations and so on. The VWP can be seen as a virtual desk in a virtual classroom. To use the facilities of a VWP, students must run their course browsers on a computer platform (Windows PCs, Workstations) and then jump to the location (URL) of the web course. After identification (username, password) they can access their private VWPs.

7.1.2 Course Provider Level

The course provider has to maintain a special course server, where all necessary databases, like courseware and student databases are located. Furthermore, authoring software must be available so that new courses can be generated. Electronic mail and teleconference systems must be installed in order to communicate and lead discussions with the students.

7.1.2.1 Course Server

The course server contains all databases for the web course. Courses are stored in the course database, data of the matriculated students are found in the student's database. The course server is maintained by the course trainer(s).

7.2 GENTLE Course Structure

This section gives a detailed description how the GENTLE courseware is stored in the Hyperwave server database. Details like Hyperwave object titles and names or Collection trees are shown with various screen shots from Amadeus and the Netscape WWW browser. GENTLE programmers and developers can find here a very comprehensive documentation of the GENTLE system. The documentation is enhanced with examples of the course 'Multimedia Information Systems' (teacher: Thomas Dietinger) to see how important attributes and PLACETemplates (features of the Hyperwave server) apply in GENTLE.

7.2.1 Structure Of GENTLE Courses

7.2.1.1 The GENTLE 'Homecollection'

The GENTLE 'Homecollection' is the parent Collection for all GENTLE course Sequences and data objects.

GENTLE Homecollection

Title = GENTLE courses
Name = courses/gentle

In this screenshot taken from Amadeus you can see the GENTLE Homecollection (http://wbt.iicm.edu/courses/gentle) amongst other Collections and Objects stored on the Hyperwave education server. Important object attributes like Author, Title and Name are also shown here. The contents of the GENTLE Homecollection are described in the following sections.

7.2.1.2 Course Content Pages And Course Entry Pages

Going inside the GENTLE Homecollection leads us to following parts of the GENTLE Courseware system:

➢ The *Course Content Pages* Collection, the location on the Hyperwave server where all GENTLE Course Sequences are stored.
➢ The *Course Entry Pages* Collection, where the entry pages needed to start a course reside.

Screenshot: A step inside the GENTLE Homecollection reveals two important entities of the GENTLE Courseware system: Collections for course content and course entry pages.

7.2.1.3 The Course Content Pages Collection

The content pages of each course are stored in Hyperwave Sequences located in the <u>Course Content Pages</u> Collection. As an example, you can see the Course Sequence '*506.032 Multimedia Information Systems*' and its contents (the modules and content pages of the course) displayed in the following Amadeus screenshot.
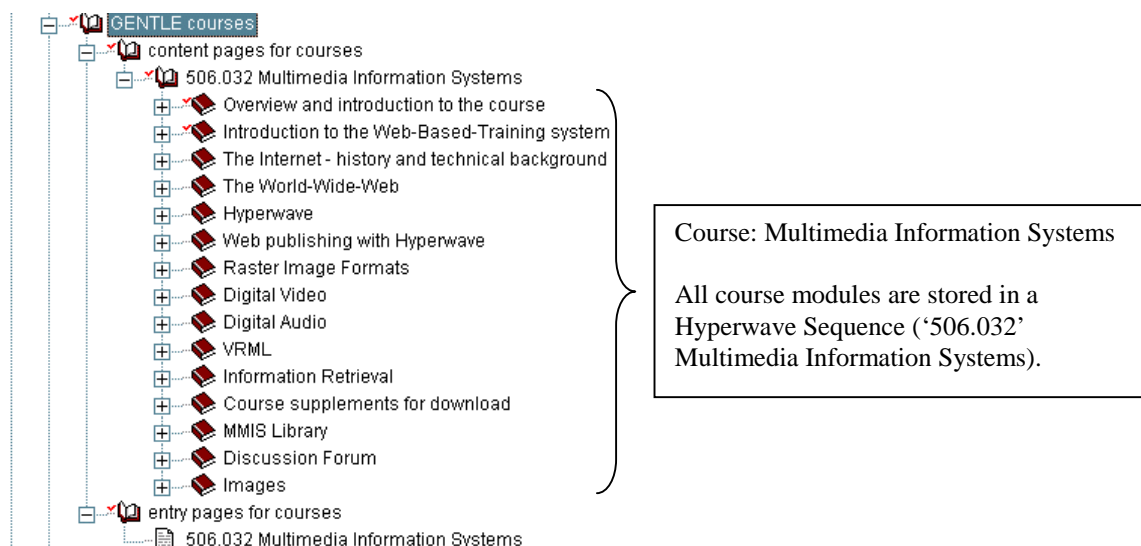
Screenshot: Amadeus' treeview of the expanded Content Pages Collection of the course '506.032 Multimedia Information Systems' revealing its structure and contents.

Screenshot: Title, Author and Name of the course sequence '506.032 Multimedia Information Systems'

Screenshot: The contents of '506.032 Multimedia Information Systems'. Here you can see all course modules and objects needed for the web based training course 'Multimedia Information Systems' (MMIS). Note that the modules are not physically copied into the course sequence; the Hyperwave linking mechanism is used instead to put modules from

the Module Repository (mr) Collection into the actual course sequence. In this case all modules, which Names have the prefix 'mr' are linked from the Module Repository.

Overview and Introduction to the course

Every course has a Sequence at the beginning of the item list which contains all information about the course and the course teacher. The sequence is created automatically by the Course Wizard. Information about the course can be edited via the Course Wizard, too.

The contents of the course introduction Sequence consists of

> ➢ A general Overview, Abstract or Introduction to the course
> ➢ Information about the course teacher and assisting staff members
> ➢ Information about the prerequisites needed for the course (both technical and knowledge)
> ➢ Information about course exercises

Course Supplements For Download

Any supplementary material for the course can be stored in this Collection. If the course is not a full sized web based training course, Microsoft Power Point Slides from lectures can be put there, as an example.

7.2.1.4 The Course Entry Pages Collection

As mentioned before, there is also a Collection for so-called 'course entry pages'. This Collection contains only dummy documents needed to put on a PLACETemplate that starts the whole course when the dummy document (the 'entry page') is accessed.

Screenshot: Contents of the Course Entry Pages Collection. The object you see actually has no contents, it is only needed as 'host' for a PLACETemplate, that launches the course when the object is accessed by the course student.

<u>Screenshot:</u> This screenshot taken from Netscape Navigator displays the user interface of a course, in this case 'Multimedia Information Systems'. The PLACETemplate (PLACETemplates are used to configure the 'Wavemaster', a module of the Hyperwave server which is the WWW gateway for the Hyperwave database) of the course entry page provides the toolbar at the left. Only few additional programming is needed to provide this kind of user interface due to the features provided by Hyperwave.

7.2.2 The Module Repository

The Library-Collection is a special section of the course server. All reusable objects and modules can be found there.

The modules used in a GENTLE course are located at the Module Repository. Using the Course Wizard, the teacher is able to link or physically copy courseware modules from that repository. Each module is a Sequence.

7.2.2.1 Course Module Sample

The 'container' for a courseware module is a Sequence. Each module has one CollectionHead (a document with the Hyperwave attribute 'CollectionHead' opens automatically when its parent Collection is accessed by the user. This is useful to provide a description about the Collection contents),

'Introduction', which gives a short introduction about the module. This CollectionHead usually is a HTML document, but other Hyperwave document types could be used as well. In this Module Sample you can see the structure of the Module 'The Internet – history and technological background'. It consists of HTML documents (e.g. The ARPANET, The TCP/IP Protocol etc.) which are providing the basic knowledge about the Internet. Note: the items of a Course Module are not restricted to HTML pages, every Hyperwave document type or even Collections and its subtypes can be used. This is of special importance, because AlternativeClusters apply here when 'Adaptive Courses' are needed.

Screenshot: Appearance of the Course Module through the Wavemaster gateway using Netscape Navigator. Beside the Introduction (not displayed here) the user gets a table of contents and a navigation toolbar (at the bottom). When accessing an item of this list its contents is displayed and the user can go to the next or last item by using the arrow buttons. This is implemented by using the special features of a Hyperwave Sequence object. Note: at the end of the item list there is an object called 'Whole lesson for printing'. This is an

MultiCluster, which contains all the documents of the Course Module, so that students easily can print the whole lesson or save it for their own purposes on disk.

7.2.3 PLACE Template Usage

This section describes another important part of the GENTLE web based training system, that is the use of PLACE Templates. As mentioned before, the PLACE Templates (along with JavaScript programming) provide the user interface for the GENTLE courses.

The PLACE Templates for GENTLE reside in the Collection 'Gentle Templates' (The Name attribute for this Collection on the Hyperwave server is 'gentle/templates/') To the right you can see a screenshot taken from Amadeus displaying the various PLACE Templates needed for the various functions of GENTLE.
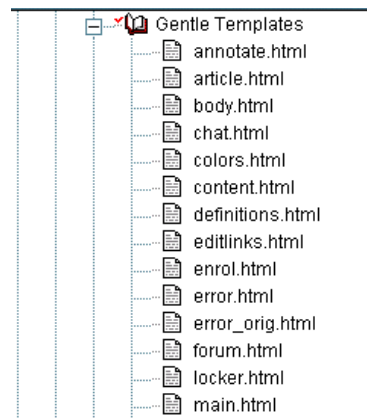
7.2.3.1 Important PLACE Templates

The most important PLACE Templates of the GENTLE system are the Templates that provide the user interface and the discussion forum.

PLACE Template 'content.html'
(Hyperwave Name: *gentle/templates/content.html*)

All course items located in the Course Content Pages Collection are accessed through the Template 'content.html' (exception: the discussion forum has it's own template, which is described later). This Template contains HTML, Hyperwave Placeholders and JavaScript Code needed for the user interface of the course (e.g. navigation buttons and annotation facilities etc.)
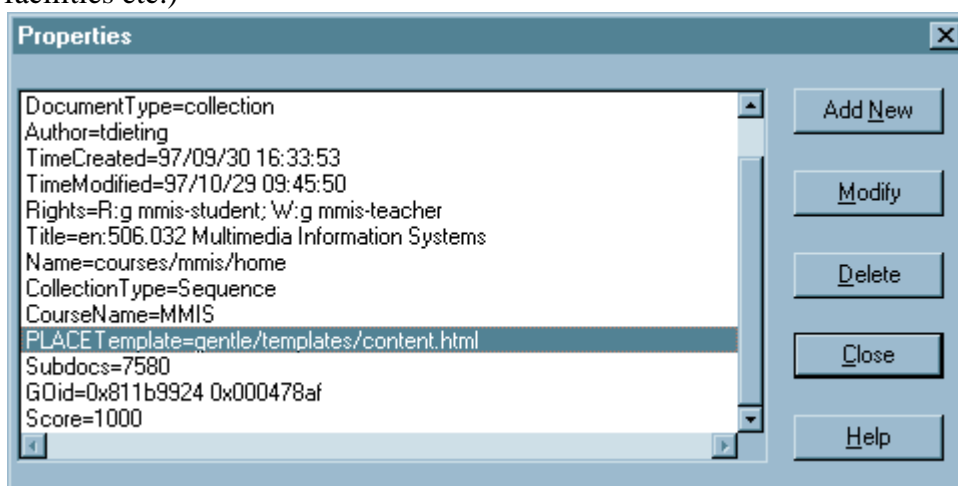
Screenshot: This image displays how PLACETemplates can be 'attached' to Hyperwave objects, in this case the Course Sequence for '506.032 Multimedia Information Systems'. Amongst other Hyperwave object attributes there is an attribute called 'PLACETemplate'. The value of this attribute is set to the name of the PLACETemplate ('gentle/templates/content.html') that should be launched when the object is accessed.

PLACETemplate 'main.html'
(Hyperwave Name: *gentle/templates/main.html*)

The objects located in the Collection Course Entry Pages are accessed with the Template 'main.html'. This Template starts the GENTLE course.
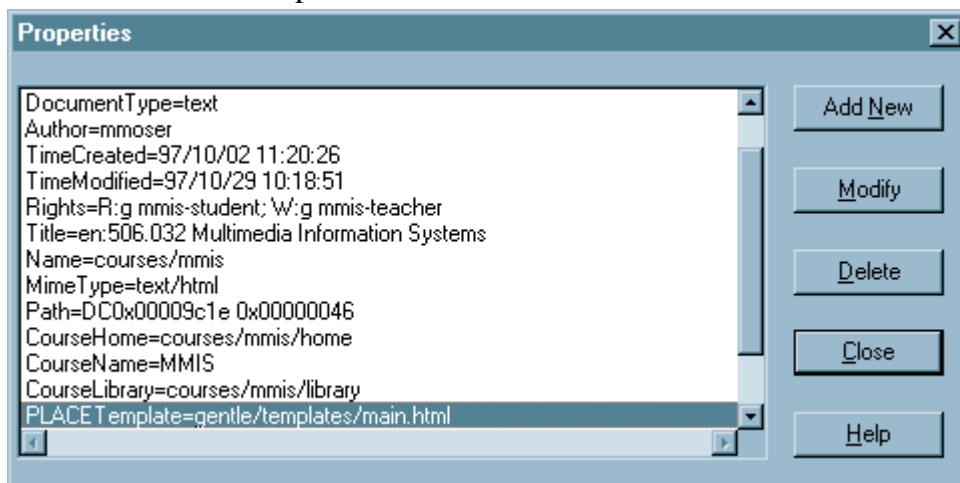
Screenshot: Amongst other document attributes (e.g. CourseHome, CourseName) the PLACETemplate for the dummy document which starts the course '506.032 Multimedia Information Systems is set to 'gentle/templates/main.html'.
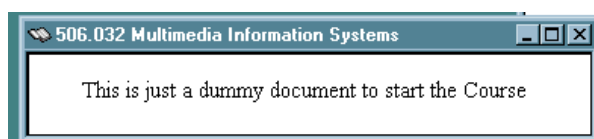
Screenshot: The 'entry page' document is only a dummy document needed to apply the PLACETemplate 'main.html' which is responsible to start the course.

7.2.4 The Background Library

Each course can be extended with a Background Library, containing additional information on the topics taught in the course. The Items for the Background Library can be selected and copied (linked) from the 'Online Library', a special collection on the education server.

7.2.4.1 Example: Contents of MMIS 'Background Library'

As an example, you can see the contents of the Background Library of the course 'Multimedia Information Systems'. Various topics concerned with Internet Information Systems are stored in this Background Library. For example, students can take a CGI Tutorial to learn more about programming the Common Gateway Interface or can read important 'Requests For Comments' (RFCs), a kind of Internet documentation standard.
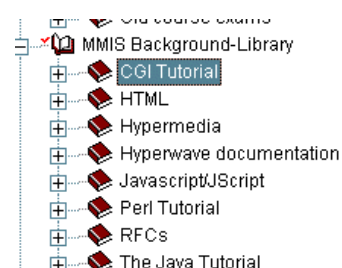
7.2.4.2 The Online Library

The Online Library is the central electronic library on the education server. All items you have seen before in the Background Library are logical copies from the Online Library. To the right you can see the treeview structure of the Online library, containing a few items. Of course, the library can be extended merely without limits.
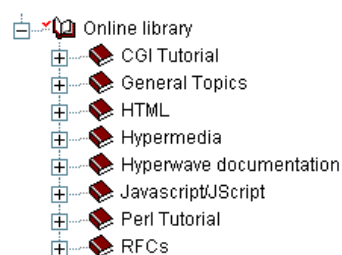
7.2.5 Contents of 'Discussion Forum'

Important: This enables the Discussion Forum for each Course !
Note the various additional properties !
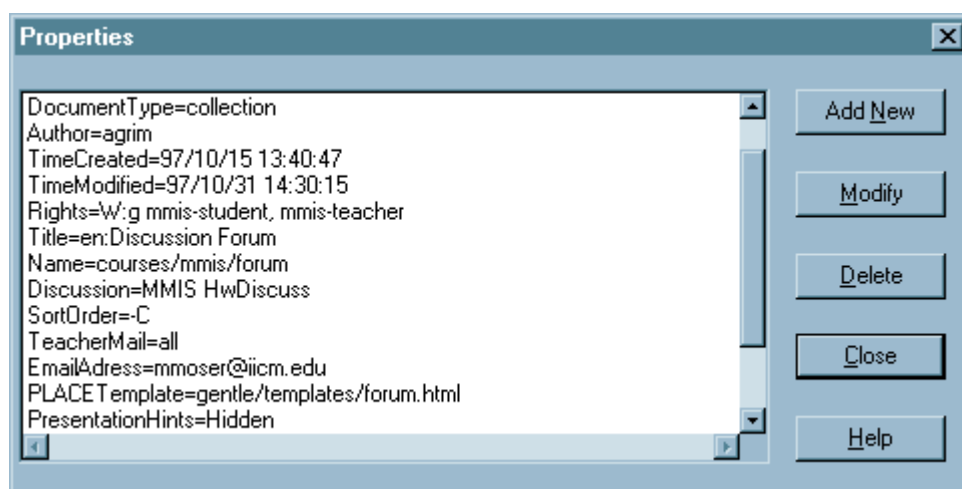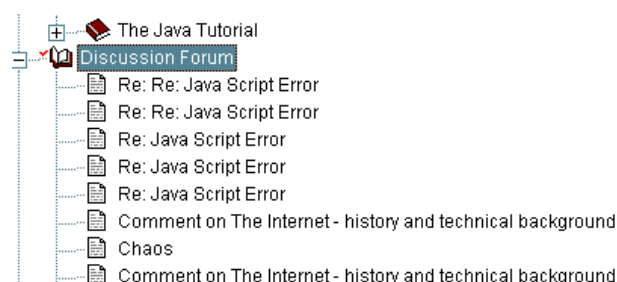
7.2.6 Contents of 'Images'

Hidden Collection for various images needed for the user interface.

7.2.7 The Student's User Interface For GENTLE

In this section we will have a closer look on the student's user interface for GENTLE. First, students must identify themselves to access their private learning environment on the course server. See also [Dietinger 1997a] and [Dietinger 1998]

7.2.7.1 Student Identification

In order to attend the GENTLE course environment, students have to identify. Certain features are also available to anonymous users. New students get a username and password after they have filled out the student information form and the Profiler, which is described in the next paragraph.

Student Information and Profiler

Students new to the GENTLE learning system are asked for

- **Name**
- **Register Number**
- **Studies**
- **Groups of Optional Subjects**

Additional to this questionnaire, a so-called Profiler can be implemented. The Profiler is a little test (Meeker Test) to find out the background knowledge and learning style of a student. This information is very important for the use of adaptive courseware. After the system has gathered background information about the student, a Virtual Working Place or 'Locker' for the student will be created on the GENTLE course server. It is the private learning environment for each student which can be only accessed with username and password.

7.2.7.2 The Virtual Working Place or 'Locker'

The VWP is a special area within the student's home collection on the GENTLE course server.

VWP Contents and Sub-Collections

- **Information / Newsboard**

  News and course announcements for the students can be retrieved in this VWP sub-collection. It is implemented with a MultiCluster containing logical copies of documents containing the announcements. The student has the possibility to erase these items from this Collection. Announcements can also vanish automatically, when an expiration date has been set by the course teacher.

- **Courses Suggestion / Career Plan**

  The system can automatically suggest courses for a student depending on the background knowledge, student profile and a career plan. A list of required courses to finish studies on a specific subject or a whole career plan for employees can be stored in this VWP Collection. In the simplest case, all courses available would be listed here. Students have to choose a course from this list to enrol.

- **Courses Enrolled**

  All current courses of a student are stored in the Virtual Working Place. It is the main entry point for the student to start and continue GENTLE courses.

- **Courses Finished**

  All courses a student already has taken can be found here. Marks and additional information about exams and tests can be stored in the Courses Finished Collection, too. Furthermore, students can access 'old' courses to have a hypermedia reference to learned subjects for later use.

7.2.7.3 The Course Environment

The course environment (implemented by using a special course PLACETemplate) provides access to the following functions and navigational aids:

- **Next Page Button: Step Forward in Course Content**
  The next course page is accessed with the 'Next Page' button.

- **Previous Page Button: Step Back in Course Content**
  Go to the previous course page by pressing the 'Previous Page' button.

- **Search Button: Search the Online Course Database**
  Access to the GENTLE search facility. Students can select the search scope, e.g. search in the background library, the course content, the discussion forum or the whole course server. The Hyperwave server system offers full-text search capabilities.

- **Annotate Button: Make Annotations and Comments**
  Annotations can be made to all items and text parts contained in a course. This can be used if questions arise or if students want to make some comments on a subject. Annotation attributes can be set to make a *private* or a *public* (readable for all course participants) contribution to the course. Public annotations will be readable in the discussion forum, too. The Annotation feature plays an important role in asynchronous GENTLE communication. There are different types of annotations, which are visualised with different icons in the discussion forum:
    - Private Annotation
    - Public Annotation (comment)

- (Public) Question to the instructor/assistant
- Answer Annotation (teacher only)

If an annotation is of type 'question', an E-Mail will be sent to the teacher to notify her/him about it. After the instructor has answered the question in the form of an 'answer annotation' it will be public readable.

Note: The annotating document as well as the annotated document can (theoretically) be of any type (audio, video, whiteboard, ...), however only with text documents all features are available.

- **Discussion Forum Button: Enter the Discussion Forum**
  Go to the *GENTLE Course Discussion Forum*. All annotations, questions and answers to a course can be found there. Each discussion thread will be hierarchically visualized. Integration with the annotation facility is tight, thus it is possible that an annotation might become the main article for a new discussion thread. A discussion article may be any document type. The GENTLE course Discussion Forum can be moderated by the web teacher (a posted article has to be checked on relevant contents and afterwards released to public). In an un-moderated discussion forum every article will be immediately visible after posting. The Discussion Forum allows asynchronous teacher-student and student-student communication over the network. This can be very useful when problems to a specific topic or document arise. A discussion can be launched to get a solution visible to all students.

- **Online Chat Button: Join Synchronous Communication**
  Start a java-based *Text Chat Application* for synchronous communication between students. The online chat can be used if more people are online at the same time. Students can chat amongst themselves or even with the teacher within the office hours. Text phrases may be supported by drawings on a Whiteboard, but in theory any document type is allowed (especially audio documents as an alternative to text). A possibility to archive chat sessions (especially student-teacher chats) should be made available (and are afterwards treated like an asynchronous discussion).

- **Exit Button: Leave the Course System**
  Leave the course and go back to the Virtual Working Place ('Locker').

7.3 GENTLE Course System Modules

7.3.1 The GENTLE Course Wizard (GENTLE-CW)

The **Course Wizard** (CW) is an authoring tool for the Course Teacher to build a brand new course on the GENTLE education server. Furthermore it can be used to edit and maintain existing courses. Course Wizard User's Manual:

Course Skeleton
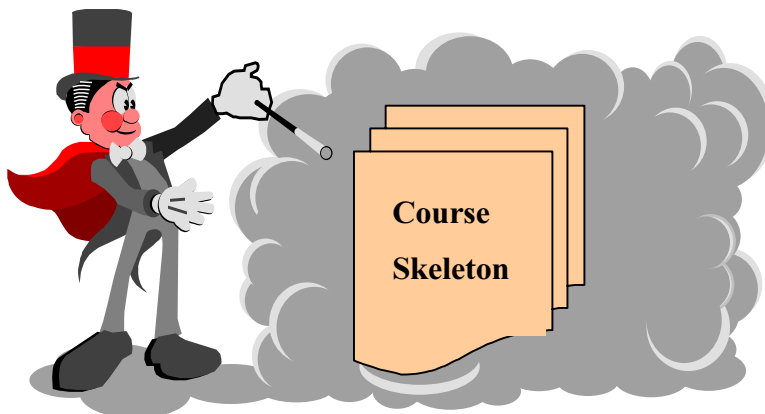
The main tasks of the Course Wizard are:

- Maintenance of existing GENTLE Courses
- Creation of a brand new GENTLE Course

Using the Course Wizard, course teachers can...

- **Edit Course Title**
  Course Keywords can be edited to specify the course subject. For example, if the Course Title is 'Multimedia Information Systems', Course Keywords can be set to 'Informatics, Information Systems, World Wide Web, Hypermedia, Multimedia, HTML, ...' to create a more precise definition about the course contents. These special keywords categorise the course content for the *Course Manager,* another GENTLE course system module.

- **Edit Information about the course teacher and supporting staff**.
  Items like Teacher's name, position, office address, offices hours, e-mail address, web page, phone number and a picture can be edited. Additional information about any supporting staff members can be entered, too.
  Note: The fields for information about the teacher are pre-set and needs to be filled out only if something changed since the generation of the teacher's profile.

- **Edit a short Overview (Abstract) on the course contents, tasks and aims**.
  The teacher should give a short introduction about the course contents and tasks. For example, the Overview for 'Multimedia Information Systems' could be as follows:'The course gives the basic knowledge about multimedia and hypermedia information systems. Topics like the Internet, the World Wide Web and various hypermedia document standards will be discussed.'

- **Edit further information on course exercises**.
  If there are any exercises for course students, the teacher should also enter information about it.
  Example 'Multimedia Information Systems': 'Exercises: As an exercise, students have to choose from different hypermedia projects. Your task will be to create or enhance a World Wide Web information server with all kinds hypermedia documents. You have to form groups of three students in order to complete your assigned task. Every group member should fulfil a specific task, e.g. HTML coding, picture scanning, information gathering and so on. If problems arise, contact the course teacher or assisting staff members (tutors) via e-mail or discussion forum to get help. Examples of last year's exercises can be found on the GENTLE education server in the exercises area.'

- **Edit information on prerequisites needed to master the course**.
  Students need certain prerequisites to master a course. This can be theoretical and practical knowledge about related subjects as well as specific technical requirements.
  Example 'Multimedia Information Systems': 'Students must have basic knowledge in computer programming and network technology to have no problems with the course content. In order to access the course, students must have a workstation (Windows / Mac / Unix) connected to the internet or campus network. For working at home students need a modem, with at least 28.8 kbps.'

- **Edit expected time for theoretical course content and exercises.**
  The course teacher should enter the average time to successfully complete the theoretical course content and the course exercise.

- **Select Background Library Modules from the Online Library to enhance the course with literature and related topics.**
  Like with the course modules, library modules can be selected to create the course background library so that students can access additional material and references on the course topics (supporting material). If the online library is really huge, the teacher is able to specify the subject area by using keywords to reduce the list of available material.

Thus, the Course Wizard builds a '*Courseware Skeleton*' on the Server with all important information and modules needed for a new course. You can use the Course created by the Course Wizard immediately or, if you wish, it can be enhanced with further courseware material at any later time. The '*Course Skeleton*' built by the Course Wizard is fully functional: All information about the course can be accessed by the students, additionally the course is supported by a discussion forum and a background library, if the instructor selected some items during the course creation process. Of course the students would benefit much more from the system if the teacher decided to create an online course content. For this purpose the instructor may use the *Page Wizard*.

7.3.2 Technical Description Of the GENTLE Course Wizard

7.3.2.1 The Course Wizard Collection Items

All items of the Course Wizard Application are stored in the '*CourseWizard*' Collection on the education server. See the treeview of the CourseWizard Collection to your right (<u>Screenshot</u> taken from Amadeus)
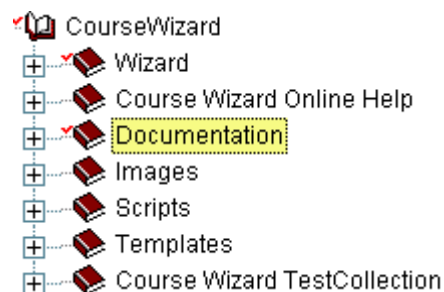
General Description of The CourseWizard Collection Items

- **Wizard (Sequence)**
  The Course Wizard Application. This Sequence is the entry point to start the Course Wizard.

- **Course Wizard Online Help (Collection)**
  Contains all documents needed for online help.

- **Documentation (Collection)**
  Technical documentation of the GENTLE Course Wizard.

- **Images (Collection)**
  Image files for the Course Wizard's user interface.

- **Scripts (Collection)**
  Hyperwave script objects for the Course Wizard's Perl-CGI scripts stored on the server.

7.3.2.2 The Course Wizard And The GENTLE WBT System

The Course Wizard
Application is stored in a
special Sequence on the
Course Server.

The Course
Skeleton is
created in the
Courseware
Database by
HWTools

HG-CSP

The CW-User-Interface
is accessed via the WaveMaster
Gateway and the use of
CW-PLACETemplates

HTTP

User Data from CW-HTML-
Forms is sent back to CW-
CGI-Scripts on the Course
Server

Course Author
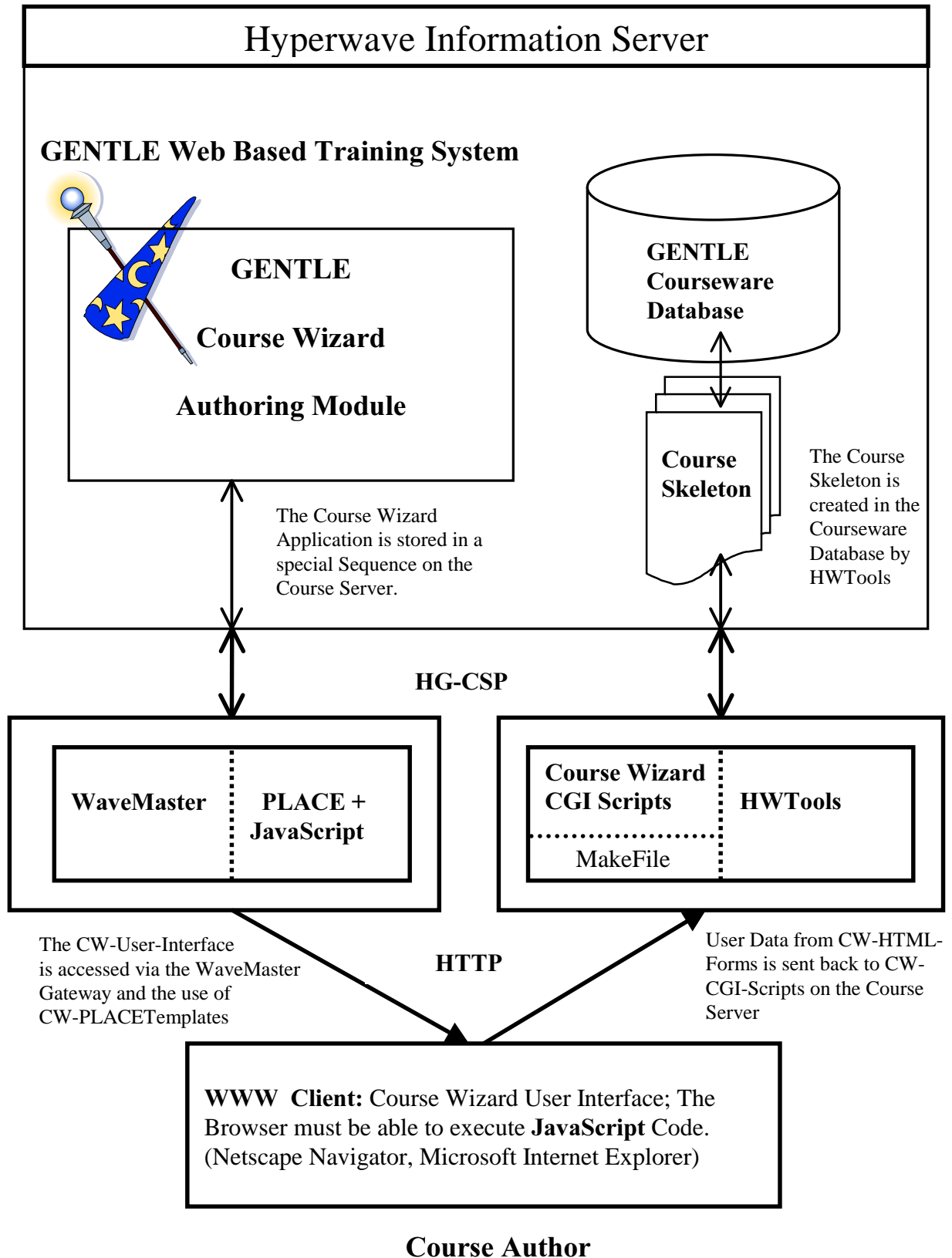
7.3.2.3 The Course Wizard Application Sequence

The whole Course Wizard Application is based on the features of a Hyperwave Sequence Object. Sequence allow easy navigation through multimedia content pages. The 'Wizard' Sequence is enhanced with the 'Twizard_sequence' PLACE-Template, which provides the Course Wizard User Interface. The PLACE-Templates are using 'placeholders' from the PLACE language together with JavaScript commands.
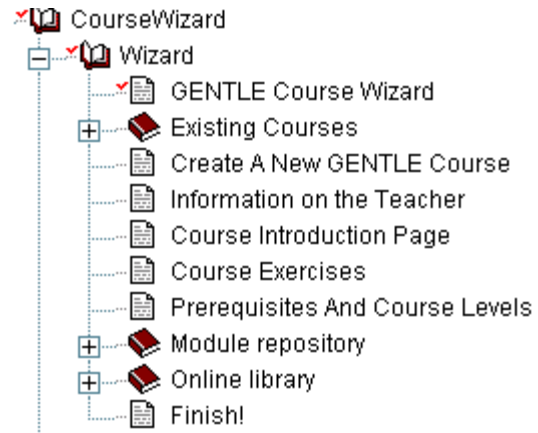
7.3.2.4 Course Creation Process

The CW is started by accessing the '*Wizard*' Sequence with the PLACETemplate 'Tcw_sequence' attached providing the user interface. Each click on the Back/Next button sends the input to a CGI script 'mf_creator.pl', which is creating a Course Makefile. All existing courses are stored as logical copies in '*Existing Courses*' to edit and administrate them (not fully implemented yet). The following objects are HTML pages containing forms for user input. Again, the data of these forms is sent to 'mf_creator.pl'. '*Module Repository*' is a logical copy needed to select Course Modules, selection user interface is provided by the PLACETemplate 'Tcw_sequence'. The same goes for the '*Online library*'. '*Finish!*' is a HTML page that ends the Course creation process – it starts the CGI script 'make.pl', which parses the Course Makefile and uses the HWTools to install the Course Skeleton on the server.
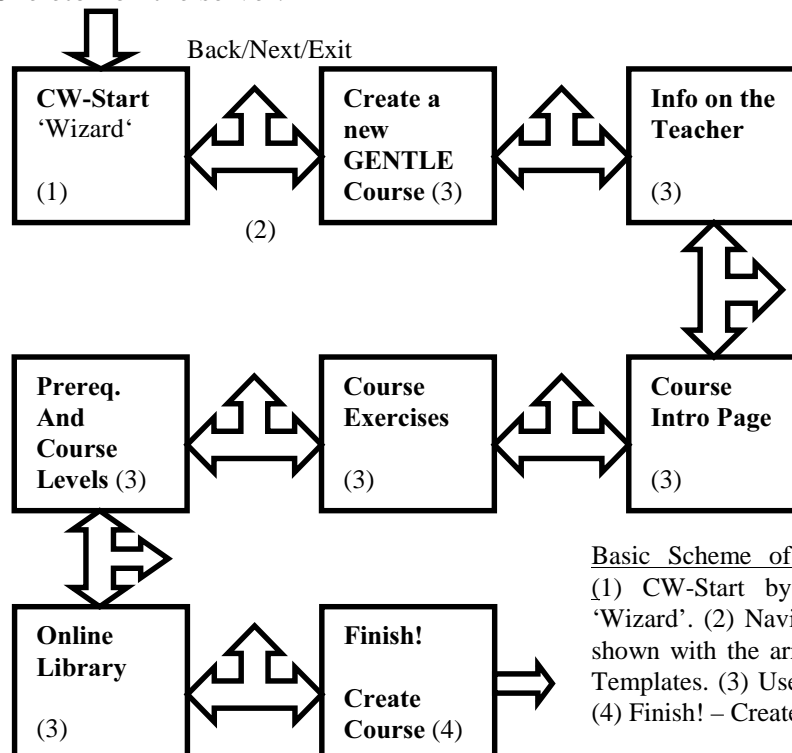
Basic Scheme of the Course Wizard Sequence (1) CW-Start by accessing the CW sequence 'Wizard'. (2) Navigation: Back / Next / Exit - as shown with the arrows. Implemented with PLACE Templates. (3) User Input at each box shown here. (4) Finish! – Create Course Skeleton.

7.3.2.5 Course Wizard – Table of Objects and Functions

Wizard Item	Type	Function / Description
GENTLE Course Wizard	HTML	Application entry / welcome page Form action = mf_creator
Create A New GENTLE Course	HTML	Course Title, Course Type Form action = mf_creator
Information on the Teacher	HTML	Teacher & Staff infos Form action = mf_creator
Course Introduction Page	HTML	Course Overview Form action = mf_creator
Course Exercises	HTML	Infos about Course Exercises Form action = mf_creator
Prerequisites & Course Levels	HTML	Prerequisites to finish the Course Form action = mf_creator
Online library	Collection	Logical Copy of the Online Library Form action = mf_creator (via PLACE)
Finish!	HTML	Create course. Start make.pl on the course server. Form action = make_course

7.3.2.6 Course Wizard Scripts & PLACETemplates

Actually, the Perl-CGI scripts are stored in the file system of the course server. In order to access these scripts special Hyperwave '*Script Objects*' have to be created ('*MakeFile Creator*', '*MakeCourse*'). The PLACETemplates (responsible for the User Interface) are stored in the Collection 'Templates'. 'Wizard Sequence Template' is used to generate the main user interface for the course author. 'Help Page Template' provides the online help for the CW.
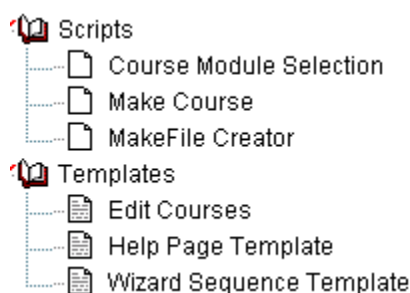
- '**MakeFile Creator**'

  All user data from the Course Wizard forms is sent to the script 'MakeFile Creator'. This program writes the data needed for a new course (e.g. Course Title, Course Teacher) into the Makefile, which resides in a directory on the Course Server. The Makefile is later used by the 'Make Course' script.

- '**Make Course**'

  This script is launched on the Course Server when the course author has pressed the 'Finish!' button. It parses the data stored in the Course Makefile created by the 'MakeFile Creator' and together with the HWTools the Course Skeleton is created on the Course Server.

7.3.2.7 The Hyperwave Tools (HWTools)

The Hyperwave command line tools (HWTools) are needed so that CGI scripts can insert Hyperwave Documents via the Hyperwave Client-Server Protocol (HGCSP). The following HWTools are used by the Course Wizard:

- HWInstext
- HWInsdoc
- HWModify
- HWInscoll
- HWMvcp

7.3.2.8 Course Wizard Online Help

The Course Wizard Online Help Files are stored in the 'Course Wizard Online Help' Collection on the Course Server. Help is accessed with the 'Help' – Button provided by PLACETemplates and JavaScript. A special
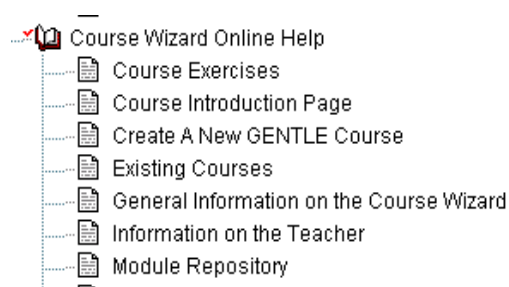
Help PLACETemplate 'Tcw_help' opens a new browser window to display the Helpfile.

7.3.2.9 Sample Makefile

To see the functionality of the Course Wizard MakeFile, here an example:

MakeFile Syntax

The Makefile is a plain text file created by 'MakeFile Creator'. It is stored in the Course Server's file system.

Comments: all lines starting with '#' are not interpreted by 'Make Course'.
Section Tags: <section_name> , </section_name>

These 'Tags' are used to sign the various data sections in the Makefile.

Commands: <command> <command_line>

The commands are interpreted by 'Make Course' to create the Course Skeleton together with the HWTools.Example: TITLE MultiMedia Information Systems sets the Course Title;
MR:link mr/wbtintro logically copies the module 'wbtintro' from the Module Repository into the new course.

Example of a Makefile
```
# ================================================================
# * * * Course Wizard Make File * * *
# ================================================================
#
<ctypeselect>
#
# Title and Keywords, Course Type
#
TITLE MultiMedia Information Systems
KEYWORDS Internet, WWW, Hypermedia, Multimedia, Document Formats
COURSETYPE WBT
<\ctypeselect>
#
<tinfo>
#
# Information about the course teacher
#
TEACHER_NAME Thomas Dietinger
TEACHER_POS University Assistant
OFFICE_ADRESS
OFFICE_TIME
[...]
<mselect>
# Course Module Selection
#
MR:link mr/wbtintro
MR:dont mr/Internet
[...]
```

7.3.3 The GENTLE Page Wizard (GENTLE-PW)

The **Page Wizard** (PW) is an utility for the following tasks:

- Design and creation of a brand new course page
  The course author can choose from several different templates when creating new pages. Example: Traditional Lecture Templates as an accompanying material to a talk (page must not be larger than screen size, 'Slides'), Special Colour and Layout Templates for pure online courses and so on.

- Edit an existing course page

- Use of additional (custom) editing tools to rework the course page
  This is a very important feature of the Page Wizard: It integrates any kind of editing tool according to the authors preferences. Example: HTML-Editors like Microsoft Frontpage, HM-Card, Macromind Director or other Hypermedia applications.

7.3.4 The GENTLE Module Manager (GENTLE-MM)

The **Module Manager** (MM) is responsible for the management of the Module Repository. Tasks of the Module Manager:

- Management of a bigger amount of Course Modules stored in the Module Repository Collection on the GENTLE server

- Categorisation of each module to simplify access (see Course Wizard) and administration.
  It is very important to categorise Course Modules, because then it is possible to automatically generate a completely new courses out of already existing material just by specifying some keywords in the Course Wizard.

7.3.5 The GENTLE Course Manager (GENTLE-CM)

The **Course Manager** (CM) is a tool to automatically assign courses to students according to their profile or career plan. The suggested Courses are stored in the 'Courses Suggested' Collection in the student's Virtual Working Place (VWP).

7.3.6 The GENTLE Off-line Wizard (GENTLE-OW)

The **Off-line Wizard** (OW) is used to create a special Off-line version of a course. This version will work without the GENTLE education server at workstations without permanent Internet or campus network connection. It is a hybrid CBT/WBT solution with features like searching and adding private annotations. Students can connect to the GENTLE education server from time to time via a modem to synchronise the Off-line content (e.g. Annotations, Discussion Forum, Announcements) with the server system.

8 Appendix

8.1 WBT Sample Exam

This example has been taken from a WBT course for employee training at the Lawrence-Livermore National Laboratory (http://www-training.llnl.gov/wbt). It is the final exam (used as self-assessment tool for students) of a course for New Employee Safety Orientation. The multiple-choice test is programmed with a CGI script and the results are automatically e-mailed to the course instructor.

HS0001-W New Employee Safety Orientation

is an evaluation of your understanding of the concepts in the New Employee Safety Orientation, HS-0001.

1. If a hazardous chemical leaked or spilled, where would you find the MOST information about cleaning it up?
    ☐a. Warning label ☐b. Material Safety Data Sheet

2. You must be informed about chemical hazards in your work area.
    ☐True ☐False

3. Who has the primary responsiblity to inform you about hazardous chemicals you use at work?
    ☐a. co-workers ☐b. company indicated on label ☐c. your supervisor ☐d. hazards control

4. If a chemical can cause fires, what kind of chemical hazard is it?
    ☐a. physical ☐b. health

5. If you see asbestos which is not properly contained you should:
    ☐a. pay no attention because there is no such thing as an asbestos free environment.
    ☐b. contact your supervisor or call Hazards Control.

6. To see a copy of the Health and Safety Manual, you need special permission from your supervisor.
    ☐True ☐False

7. Check the true statement:
    ☐a. it is up to your supervisor to read to you the labels of hazardous materials.
    ☐b. it is up to your supervisor to train you to understand the labels of hazardous materials.

8. It is OK to eat lunch where the Hazard Notice Door Poster states there is lead dust.
    ☐True ☐False

9. Who is responsible for YOUR safety?
    ☐a. You
    ☐b. Hazards Control Department (your health and safety department)
    ☐c. Your supervisor

10. The emergency phone number is 911
    ☐True ☐False

11. If you are on site using a cellular phone reporting an emergency, you should dial
    ☐a. 911 ☐b. 447-6880

12. If you find or have a safety problem, to resolve it, the first step is to contact:
    ☐a. DOE ☐b. Your supervisor ☐c. Hazards Control Department ☐d. Safeguards and Security

[...]

When you are satisfied with your responses, click **Submit** **for automatic processing.**

8.2   GENTLE Course Wizard: User's Manual

Screenshot: The GENTLE Course Wizard Title Page
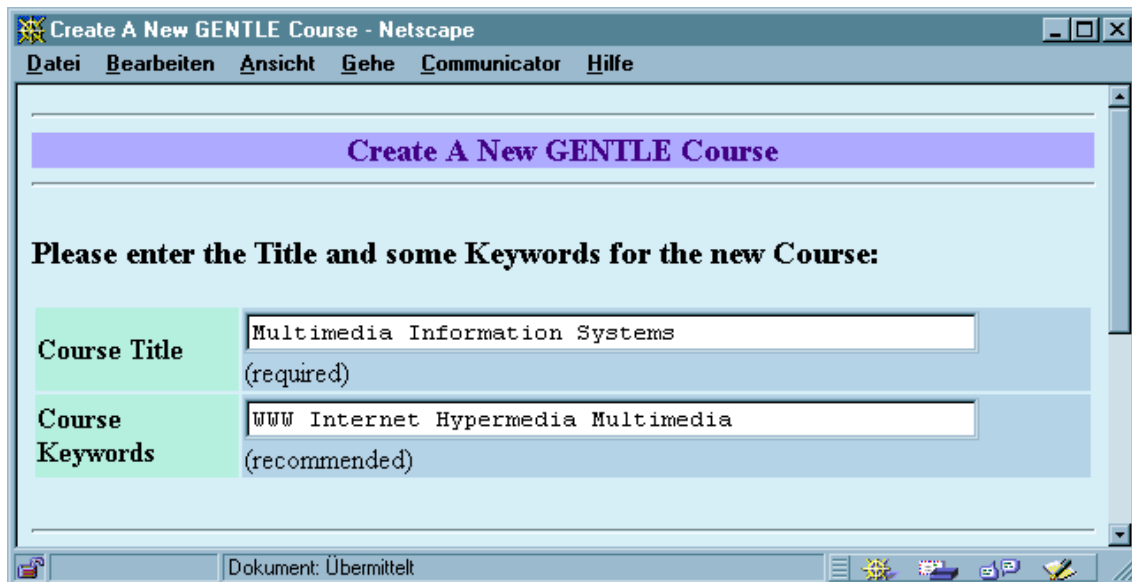
8.2.1 General Course Wizard Navigation Features

Start the Course Wizard (CW) by pressing on the '**Next**' Button. You can always leave the CW by pressing the '**Exit**' Button. **Online Help** to the Course Wizard is provided with the '**Help**' Button. Use the '**Back**' Button to go back, when you want to re-edit your input.

8.2.2 Creation Of A New GENTLE Web Based Training Course

First, you have to enter a **Course Title** for your new GENTLE course and some optional **Keywords** to specify the teaching subjects.

See the Example below:

Screenshot: Course Title and Course Keywords

This example shows the creation of a course on multimedia information system. The **Course Title** is set to '*Multimedia Information Systems*' and the Course Author has set the **Course Keywords** to '*WWW*', '*Internet*', '*Hypermedia*' and '*Multimedia*' in order to classify (Course Classification) the course topics and content. The Keywords are very useful when creating a Career Plan for a student or to suggest courses. If the Career Plan would require Internet or Hypermedia subjects, all courses which Keywords contain these words would be suggested.

8.2.3 Teacher And Supporting Staff Information

The next step is to give some **information about the Course Teacher** (Web Teacher) and the supporting **Staff Members** (**Tutors**), if there are some. All inputs on this page are optional.

Example:

Screenshot: Information about the Course Instructor

You can enter the following items: **Teacher's Name**, **Position**, **Office Address**, **Office Hours** (when students can meet the teacher at his office), **E-Mail Address** (important for student-teacher communication!), **Phone Number** and **FAX Number**. In case there is a **Course Logo** stored on the Hyperwave server, you can enter the name of the logo. It will be displayed in the top-left corner of the Course Environment. If there are more announcements to make, you can use the text box labeled with '**More...**'.

8.2.4 Information about the Supporting Staff

Many courses have not only a Course Teacher but also a **Supporting Staff**. You can enter the names and additional information (e.g. the e-mail addresses of each staff member) of the supporting staff in the text box labeled with '**Supporting Staff**'. The GENTLE Course environment offers a Discussion Forum for the students. Questions are automatically sent to the email addresses specified in the **Staff Email** text box. At least one email address has to be specified in this field.
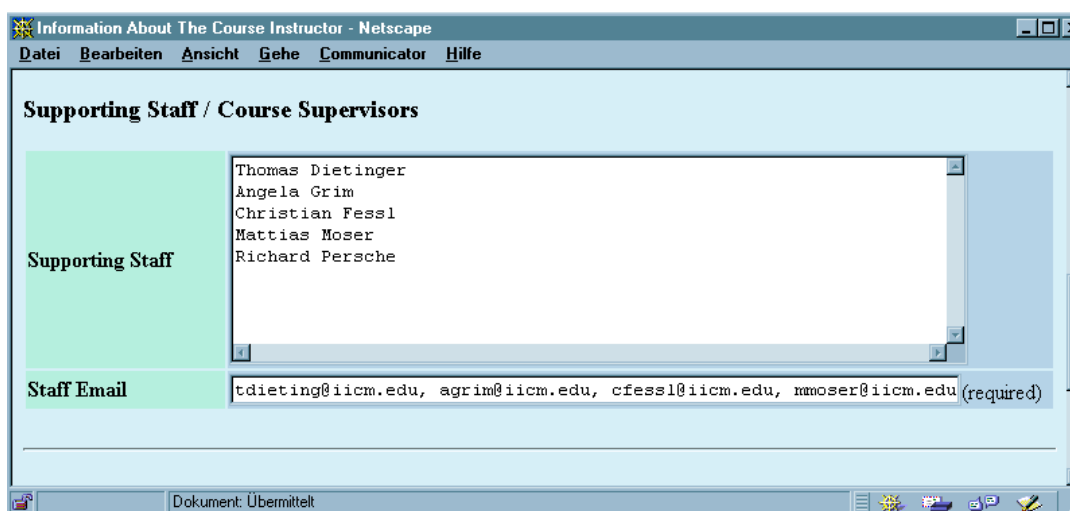
Screenshot: Information about the Course Supervisors.

In this example, there are five persons supporting the Course. Questions of the Discussion Forum are sent to the Course Supervisors. The Course Supervisors try to give exhaustive answers and forwarded them to the Discussion Forum.

8.2.5 Course Overview

Now it is time to enter a short **Abstract** (Overview) about the course content. It is a short description what you will teach in this course. Look at the example below:

Example:
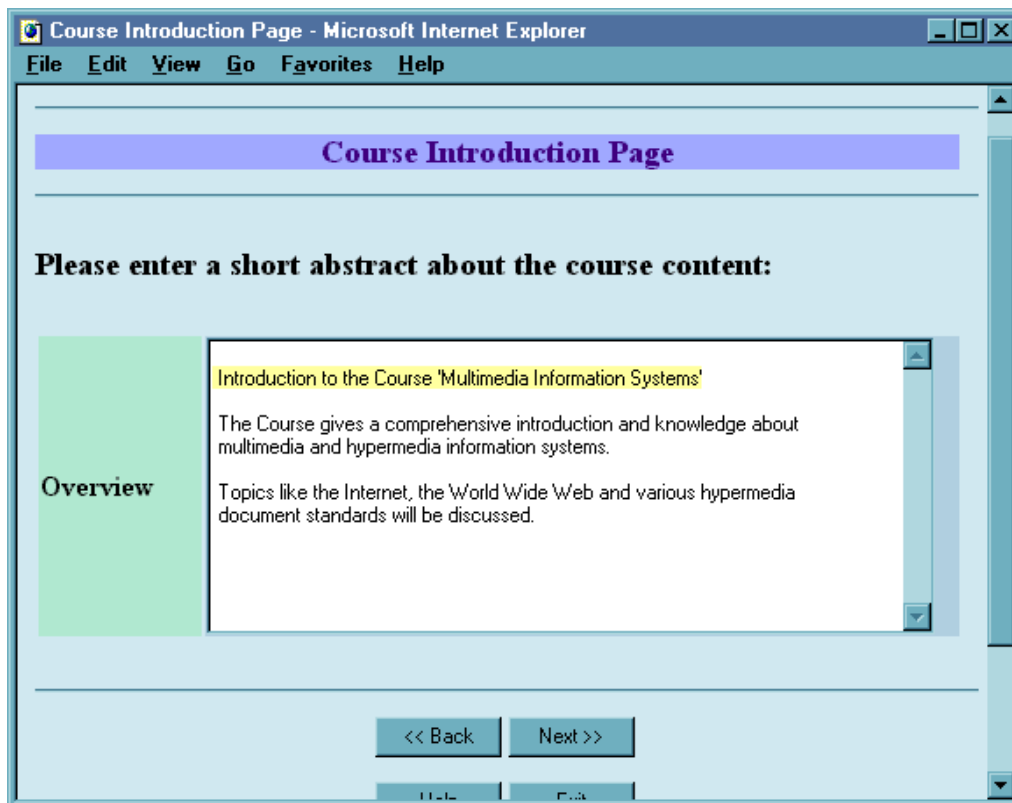
Screenshot: Course Introduction Page

This can be the introduction for the course on multimedia information systems.

8.2.6 Course Exercises

If the students have to fulfil some **Course Exercises**, you have now the possibility to give some information about it. Otherwise you can *skip* this page.

Example:
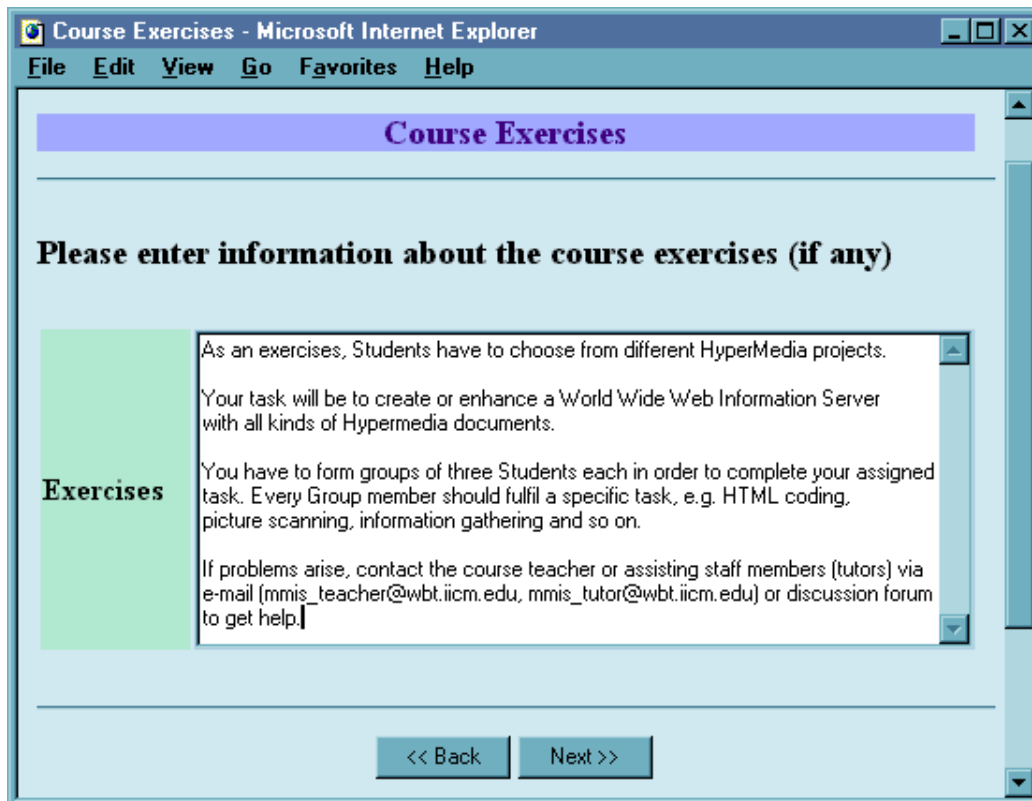
Screenshot: Course Exercises

This is an example for exercises on our multimedia information systems course. First, the teacher specifies that the students can choose from various projects. Second, the teacher outlines the mode of working (the students have to form groups of three persons in order to reach the goal). Finally, there are e-mail addresses of the teacher and the supporting staff members when the students need help on their exercises.

8.2.7 Course Prerequisites

You can specify any **Prerequisites** needed for the students to finish a course here. Prerequisites for a course can be <u>theoretical</u> or <u>practical</u> knowledge on a specific subject as well as hardware and software requirements for the client machine. Furthermore, to determine the <u>amount of time for a course</u>, the teacher can enter the average time to learn the **Theoretical Course Content** and the time to solve the **Course Exercises**.

<u>Example:</u>

<u>Screenshot:</u> Prerequisites And Course Levels

A course on multimedia information systems would require some basic knowledge about computer programming (Computer Programming Courses I and II) and basic understanding of modern computer network like the Internet. Furthermore, students need a Windows PC, a Mac, or an Unix workstation with browser software in order to access the courseware server.

8.2.8 Background Library Selection

The Course Teacher can select items for the **Course Background Library** from the **Online Library Archive**. This is the last page of the Course Wizard, so if you want to create the new Course on the server, press the '**Finish!**' button.

Example:
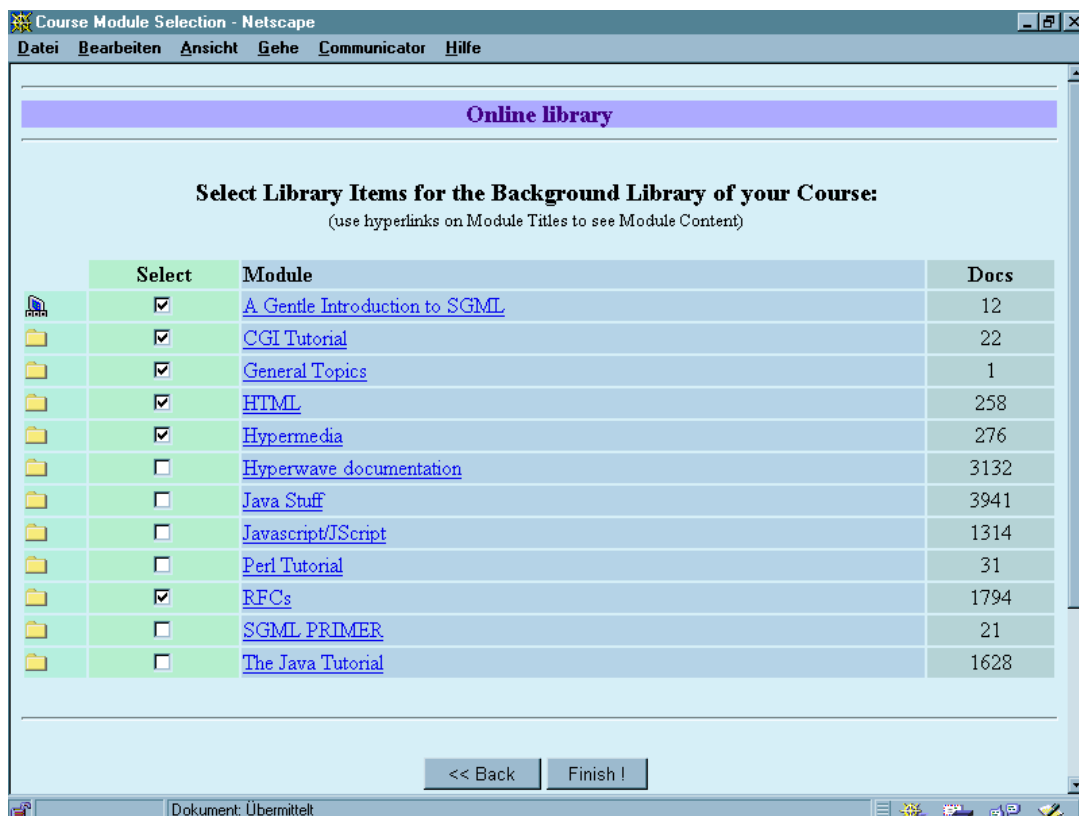
Screenshot: Background Library

The course teacher has chosen the following hypermedia items for the Multimedia Information Systems Background Library: 'A Gentle Introduction to SGML', 'CGI Tutorial', 'General Topics', 'HTML', 'Hypermedia' and 'RFCs'.

8.2.9 Finish New Course

After pressing the **Finish!** Button, your data for the new Course will be transmitted to the course server. The Course Wizard installs all <u>data structures and objects</u> needed for the new course (e.g. Discussion Forum and the Background Library).

Note: It will take some time until this action is done.

<u>Screenshot:</u> Finish!

You have now a fully functional **Courseware Skeleton** on the course server, which can be enhanced at any later time with the other GENTLE Courseware Authoring Modules.

9 References

Note: References to World Wide Web resources (W3-Uniform Resource Locator; URL) may become so called „dangling links" (e.g. the document has been erased) due to database changes on a remote W3-server.Unfortunately, the author has no whatsoever means to prevent this case.

Symbol Key:
📖 'Classic' Literature, Papers
💻 Electronic Literature and Hypermedia

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[💻 Friedman] Friedman, G. Whatever happened to Plato ? University of Illinois at Urbana Champaign.
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10 Glossary

- **Authorware** - Tools and editors to facilitate creation and maintenance of all kinds of documents.

- **Asynchronous Communication -** Communication with time delay, because the discussion participants do not have to be online at the same time. Communication via e-mail or Usenet newsgroups are an example for Asynchronous discussion and communication.

- **ATM** - Asynchronous Transfer Mode. Advanced networking protocol technology used in broadband communication

- **CAI** - Computer Aided (Assisted) Instruction. Umbrella term for application of computers and information technology in education.

- **CAL -** Computer Aided (Assisted) Learning. See CAI.

- **CAS -** Computer Aided Selling. Product marketing and selling supported by means of information technology.

- **CBL** - Computer Based Learning. Same meaning as CAI.

- **CBT** - Computer Based Training. CBT systems usually are stand-alone systems without network connection, e.g. learning and simulation systems with multi-media content stored on a CD-ROM.

- **CGI** - Common Gateway Interface. Standard interface to launch specific programs (scripts) on a WWW server, to transmit data to these programs and return results to the viewer. Interactive forms are a common application.

- **CML** - Computer Managed Learning. See CAI.

- **CSCW** - Computer Supported Collaborative Work. This is a generic term which combines the understanding of the way people work in groups with enabling technologies of associated hardware, software, services and other techniques.

- **CSL** - Computer Supported Learning. See CAI.

- **Courseware** - A generic term for all kinds of educational software.

- **Desktop Training -** Training delivered directly to the desk at the employees' workingplace.

- **Distance Education -** Specifies a learning environment without face-to-face contact between student and teacher. Distance Education is a broadcast of a lecture to distant locations by using Television and Video systems.

- **GENTLE -** General Networked Teaching and Learning Environments. Web Based Training system implemented with Hyperwave server technology at the IICM.

- **Groupware** - Software for computer supported collaborative work and work groups.

- **ITS** - Intelligent Tutoring Systems. Learning systems that allow adaptive courses and individual learning environments for each student. ITS dynamically adjust the course content to the learner's needs.

- **Internet Based Training -** A term for any training that can be accessed over the Internet. Usually this is done within the World-Wide-Web, but e-mail correspondence courses and file transfers also fall into this category.

- **Intranet Based Training** - Web Based Training systems based on a company's internal network. Standard web browsing software is used to access company web pages, which are only accessible within the company.

- **LATE -** Learning And Teaching Environment. Approach and fundamentals to Web Based Training with Hyperwave by Hermann Maurer

- **MANKIND -** Multimedia And Networked Knowledge-transfer Introduces New. MANKIND is a research project at the IICM to implement a Web Based Training System.

- **Multimedia Training -** Computer Based Training (CBT) using two or more types of media, this could be text, graphics, animation and video.

- **Net Based Training -** See Online Training.

- **Online Training -** A general term referring to any kind of training or learning done with computer systems via a network, e.g. LAN, Intranet or Internet.

- **Synchronous Communication -** Communication without time delay. All discussion participants have to be online at the same time.

- **Teleteaching -** Teaching people in different physical locations using live broadcasts (digital or analogue) and/or „canned" courseware, but at least with email feedback.

- **TS** - <u>T</u>utoring <u>S</u>ystems

- **WBT - Web Based Training -** In general, Web Based Training is learning instruction that is transmitted via standard web browsing software (Netscape Navigator, Microsoft Internet Explorer) using the Internet or a Intranet. Web Based Training is the most widely-used and widely-understood term for this kind of learning.

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