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Generic Framework for Collaborative Work Environments

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1. Introduction

The "i2010 – An European Information Society for growth and employment" initiative was launched by the European Commission on 1st of June 2005as a framework for addressing the main challenges and developments in the information society and media sectors up to 2010. It promotes an open and competitive digital economy and emphasizes ICT as a driver of inclusion and quality of life. The initiative contains a range of EU policy instruments to encourage the development of the digital economy such as regulatory instruments, research and partnerships with stakeholders. According to the European Union initiatives, this chapter proposes a generic framework that illustrates the advances of collaborative work environments where the attendees from different domains of interest can share ideas, concepts, studies, digital content and resources, in an interactive manner. The approach highlights the importance of the advanced technologies in E-Service platforms: video telephony, video conferencing, online focus group, virtual shared space, media streaming or video capture/recording functionalities. The presented prototype is developed according to the extended LAMP architecture and consists of the following blocks: Apache web server, MySQL database server, Red5 media server, OpenOffice 2.0 and GostScript libraries.
The generic framework can be applied to different domains such as business, education, telemedicine or administration and security. The chapter contains sections dedicated to collaborative work capabilities for electronic commerce and negotiating or customer live support, open and distance/blended learning, administrative real-time decission in different situations (calamities, vandalism acts), remote consulting and surgery acts. Some examples and suggestive demonstration films are also presented in the chapter in order to illustrate the advantages of the computer supported collaborative work framwork as the core of any virtual community.

2. Generic Framework for computer-supported collaborative work

The proposed framework can be considered as a multimedia distributed system that complies with the extended LAMP architecture (Figure 1) and consists of the following blocks: Apache web server that allows the end-users to access the collaborative work services, MySQL database server that stores the information regarding the end-users,

resources, innovative products and services, suppliers, customers and virtual community, and Red5 media server that provides with video telephony/conferencing capabilities, media streaming and video capture functionalities and supports the remote shared objects. The OpenOffice 2.0 and GostScript libraries are involved in order to implement the conversion block fuctionalities and allow the service handler component to organize the digital content in an unified manner. The *Business intelligence* block consists of a multi-agent platform able to learn the behavior of the actors and elaborate statistics, analytics reports and scenarios based on activity tracking. The client block allows the end-user to access the system via web or from his/her Pocket Pc.

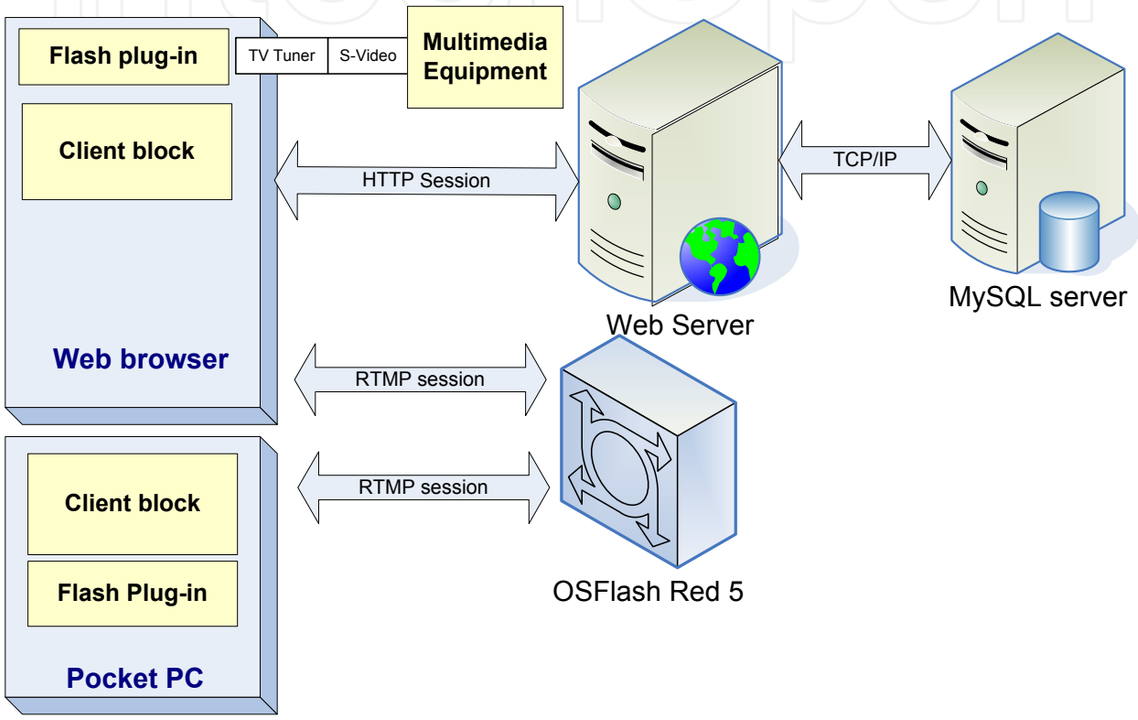

Fig. 1. Framework Architecture

2.1 LAMP-based Computer-Supported Collaborative Work

A large number of web sites are built using *PHP* and *MySQL* on *Linux* platforms with *Apache* as the web server. This combination is known as the LAMP architecture. Apache, PHP and MySQL are also available on Windows platforms giving rise to combinations like WAMP (Windows, Apache, MySQL and PHP) and WIMP (where the IIS web server is used instead of Apache). Even though LAMP is a very popular architecture there has been little work to characterize and benchmark the architecture, especially at an application level.

In reality LAMP describes any architecture that relies on an open source operating system, open source web server, open source database, and open source programming language in the implementation process. In fact, open architecture means cost effectiveness but also high performance.

The LAMP architecture guarantees several advantages such as cost effectiveness, flexibility, and scalability. The cost is the most obvious advantage of the LAMP architecture. Since each

layer in the stack is based on an open source solution, the entire stack can be implemented for the cost of development plus the cost of hardware. No piece of the stack requires software licenses. The LAMP stack is arguably easier to maintain and expand, and quicker to adjust to business requirements. If mobility is required, the end-user accesses the services using the mobile device (Pocket PC, PDA device) without any other deployment actions, just using a Pocket PC-based client application. The LAMP architecture is horizontally scalable, meaning it grows as you add hardware to it. No single piece of the architecture is a bottleneck because each piece of the stack grows on its own, and is loosely coupled to the other pieces in the stack. In that case, the system specifications highlighted the importance of the multimedia capabilities such as: video communication, media recording/streaming, virtual shared space, knowledge and application sharing. The system architect easily introduced an open source media server (OSFlash Red5) in the classic LAMP architecture in order to support the needed functionalities.

2.2 Media server block

OSFlash Red5 media server provides developers with an elegant and powerful set of mechanisms to invoke methods remotely. The client block can invoke methods on the server and the server can invoke methods in the client-side components. Method calls can be broadcast to each client component and application instance connected to a shared object or stream, or they can be sent to and from individual client component. An application instance can even create proxies of methods belonging to another application instance.

The stream and shared object *send( )* methods both provide a mechanism to send method invocation requests to multiple client components at the same time. The *call( )* methods provide a way to invoke a method on one recipient at a time. Unlike *send( )*, *call( )* makes it possible to receive the return value of a remote method. The *call( )* method can invoke methods on numerous objects attached to the client component or *NetConnection* objects. The *call( )* method provides fine-grained messaging control from client to server to clients, if necessary, and has advantages and disadvantages in securing an application.

2.3 Client bloc

The scalability is an important aspect when designing multimedia distributed systems and the proposed framework is developed according to the rules that define the scalability. The differences between the client components for the web access and the components that allow the access from the desktop/Pocket PC are insignificant. They are developed as extensions of the client-side generic components that implement basic functionalities such as: interface between the application and the peripherals (access control to sound and video blasters, or TV tuner), audio/video data manipulation (data transmission/retrieval to/from the media server), audio rendering, video playback, and handwriting/drawing features.

The client block diagram in the Figure 2 illustrates the client-side functionalities. The client block controls the microphone and web/video camera connected to the client machine, captures the multimedia data and sends data packages over a stream to the server-side component. In the same manner, the video sequences captured from the multimedia peripherals such as multimedia equipments, using the TV tuner, can be broadcasted within the shared space component.

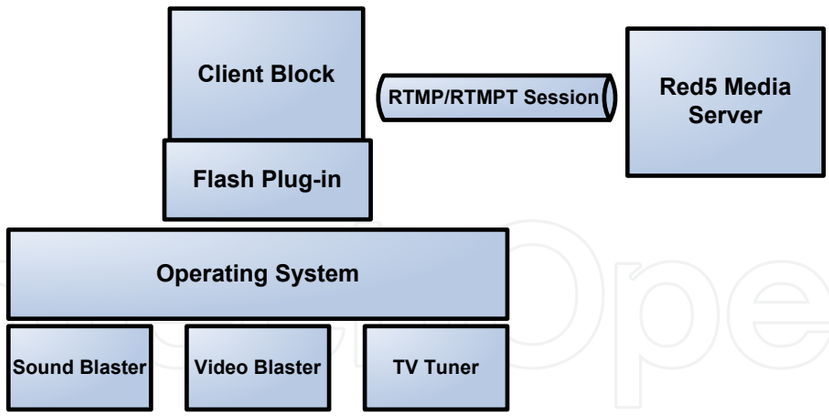

Fig. 2. Client Block Diagram

Video data transmissions can require a significant bandwidth that depends on the video parameters such as frame rate, resolution and quality (compression). If talking about a virtual community built around VPN/LAN (high-speed intranet in which bandwidth is not an issue) higher-quality transmission can be setup. Even in such cases,, there are limits to what a PC can reasonably capture, for example, the application shouldn't exceed 80% of CPU capacity on Windows. Most applications are deployed over the Internet and the bandwidth requirements can profoundly affect the application's functioning and the user experience. The proposed framework considers those aspects, that way the smallest appropriate dimensions and lowest acceptable frame rate is selected in a dynamic manner (within the bandwidth management function).

3. Computer-Supported Collaborative Work framework within virtual organizations

(Crispim & Pinho de Sousa, 2007) illustrated that business environments, especially the virtual enterprises, respect several important rules. Most of them regard the manner of creating the partnership, which is the trustworthy partner, how to search for this kind of partners or what resources, customers and suppliers to be shared within the virtual enterprise. The product manager in a virtual enterprise is able to manage the resources, the customer/supplier relationships and to analyze the value chain in a dynamically and secure manner from anywhere in the world. The tasks can be performed from the working station in the office or even from the PDA/Pocket PC, thanks to the high degree of scalability provided by the prototype described in the article. Due to the sharing capabilities and collaborative work features, the marketing functions evidently increase in a virtual enterprise. The sales can be focused on the new products and services created in the virtual enterprise or even enlarge the product categories and deliver all the products the partners usually distribute, if the partnership allows that.
The authors consider the scenario above as really important and propose a prototype for the virtual enterprises as the basis of a large scale virtual community. The prototype presents several advantages the multimodal interfaces guarantee, and combines the speech and ink formats to facilitate the creation of robust and efficient multimodal mobile E-Business systems.

3.1 Virtual enterprises and electronic market

Recent advances in communications and distributed information technologies have changed the way that business is conducted. Enabled by technologies such as software agents and e-commerce, enterprises have gone beyond the geographical and socio-cultural boundaries and have become entities that not only compete in the global market, but also draw their resources from an international market. The trend of outsourcing seems to be replaced by strategic alliances, where enterprises or individuals work together towards a common goal and share their responsibilities as well as their profits. The concept of a virtual enterprise (VE) has emerged as a means of dealing with this new type of alliance. The approach consists of the individual entities, human beings, software agents or organizations that come together as a team to achieve a specific goal. The partners co-operate to complete a set of tasks, share their skills, costs, profits, risks and markets and then move on to join another virtual enterprise.

(Camarinha-Matos et al., 2007) focused on the most important stages in the lifecycle of the virtual enterprise, formation of the virtual organization. Since virtual enterprises have a limited lifetime, they need to be formed very quickly in order to meet the deadlines of the goals. An important part of the formation of the virtual enterprise is the selection of its partners. They are selected on the basis of their ability to fulfill the requirements of the virtual enterprise. The partners have to work as a team and these requirements must address not only the individual partners of the virtual organization, but also how the partners fit into a team.

The main idea of electronic market is to create competition among buyers/sellers while allowing them to adjust all the aspects of the deal that are typically only dealt within a negotiation. This creates a problem of "comparing apples and oranges": bids may be quite different in many dimensions and therefore cannot easily be compared. Apart from the dimension of price these could include pre-negotiated discounts (e.g. for loyalty), specific qualities, combinations of goods and services with conditional pricing, freight differentials, contract fulfillment timing, payment terms, or deliberate constraints such as market share limits.

Many suppliers do not know the potential benefits that electronic market can offer and they do not believe their off-line relationships with a buyer/supplier could be transferred to the digital environment. Thus, buyers need to convince their suppliers that electronic market is not just a price based marketplace but instead a business model where mutual benefits can be achieved based on existing trust relationships between a buyer and limited number of qualified suppliers.

3.2 Actors and virtual assistance

Four types of real actors can be defined in the use case scenario: product manager, sales agent, customer and service engineer. Each one has allocated his own virtual assistant that implements presentation, notification or collaborative functionalities.

The product manager performs management tasks related to the value chain, human resources, or specific suppliers and customers of the partnership. The product manager also controls the partnership and takes important decisions based on the suggestions the business intelligence components provides with. The virtual assistant allows the actor to perform the specified activities, notifies the product manager, via SMS/email/multimedia messaging, about new economic agents in the system searching for partners, about

problems in the existing partnership, elaborates statistics about the sales process and value chain, allocated resources, and present production plans or cost approaches.
The customer usually wants to buy products/services, find more information about a specific product/service or fix a problem the bought product/service generated. In the real market, the sales agent meets the customer from the entrance with a welcome message and presents the product/service categories. In the presented approach, that role is played by the customer's virtual assistant. If the customer needs more details about a product/service, an interactive catalogue or booklet is browsed by the virtual assistant in front of the customer. There are situations when the customer wants to talk to a real agent from the sales department, so, the own virtual assistant establishes a secured communication session between the customer and the sales agent, using the Live Customer Support module.
There are situations when the customer needs technical support and his/her personal assistant must contact the technical support specialist's virtual assistant. The technical support specialist is able to offer remote assistance, so, the innovative products/services the virtual enterprise provides with are created based on that approach: the customer's desktop can be shared, a web camera can be easily integrated in the system, if necessary, or a small but useful control panel can be activated in order to allow the technical support specialist to remotely fix the problem on the customer's end.

3.3 Collaborative work capabilities for virtual assistance

The product manager's virtual assistant typically implements the secretary concept and deals with the business intelligence component in order to get the information regarding the partnerships, value chain, human resources, suppliers, customers and product lifecycle. It also presents the information to the product manager as statistics and notification messages. A high degree of interactivity is provided, that way, the product manager is able to dynamically control the virtual enterprise.
The customer's virtual assistant represents the system in the dialogue with the customer and implements the multimodal interface concept for both e-commerce and technical support sections. The role of the multimodal interface is to make the virtual market close to the real world: the virtual assistant and the real vendor in the sales process are similar. The customer's virtual assistance also implements the call center capabilities: it queries the business intelligence component that decides the type of problem the customer has, calls the technical support and establish the communication between the customer and one of the technical support specialists.
The sales agent's virtual assistant informs the sales agent about a new customer interested in buying products/services, his/her options, what product/service is selected, or different suggestions about the customer. The virtual assistant also provides the sales agent with demo films and booklets, statistics or other information during the collaborative commerce sessions. These capabilities increase the efficiency of the sales process and help the sales agent to easily do the own job. On the other side, the customer receives not just the information from the sales agent but he/she can view the selected product/service in different situations according to the demo films, how it works or state conditions and parameters it reaches during the lifecycle. The virtual assistant deals with the business intelligence component in order to get the information for the sales statistics and presents the statistics to the agent in an interactive manner: speech-based user interaction, interactive 2D graphics, animations, macros, sound, text or video.

The service engineer's virtual assistant is notified by the business intelligence component about the problems one customer met when using the product/service he/she bought from the virtual. Its main task is to establish the communication between the customer and the service engineer and allows him/her to fix the problem remotely. The decision regarding the specialist is the due of the business intelligence and it is elaborated according to the activity tracking approach. That aspect allows the customer to talk about the problems he/she met to a specialist able to fix the issues during a simple video call or collaborative session.

3.4 Product manager module

The product manager in a virtual enterprise handles the partnership, manages the value chain, human resources, suppliers, customers or the product lifecycle. He/she has an updated status of the virtual organization, can access complex statistics regarding the value chain, human resources, partnership or sales. The figure 4 illustrates the sales statistics provided to the product manager in HTML format.

The product manager's virtual assistant can easily establish communication sessions with sales agents or another person involved in the virtual enterprise processes. When the product manager and one of the sales agents use a PC2mobile private link the video communication is allowed for improving the communication features. If using a mobile2mobile communication link the system enables an audio link because of the bandwidth economy.

Fig. 3. Sales statistics

The audio and text are considered as high priority and the bandwidth needs do not raise problems. The video can be supported just when using the Wireless LAN/UMTS networks that allow big amount of data to be transferred. If the product manager invites one or more specialists in a collaborative session, the shared space component will be enabled. It allows the product manager to share resources such as documents, booklets, demo films, with the

invited specialists. In figure 5, the attendees to the collaborative sessions share the statistics that illustrates important aspects regarding the virtual organization.

Fig. 4. Video link and shared space

3.5 Customer module

The client component in the customer module offers a user friendly interface for both e-commerce and technical support scenarios. Two different sections will be implemented: the virtual store and the live customer support.

The virtual store supports speech-based user interaction and 2D interactive graphics. The multimodal interface allows the customer to browse the catalogues, select a product and buy it using the own voice. The figure 6 illustrates the virtual assistant presenting a selected product to the customer.

Fig. 5. Product presentation

When the customer needs technical support, the own virtual assistant schedules a communication session with one of the services engineers. The system setup a collaborative session and the virtual assistant of the service engineer prepares some suggestive demos, if

necessary. The real-time communication increases the efficiency and the customer can be sure of the high quality services.

3.6 Sales agent module

The notifications about a customer interested in buying products/services include the customer's options, some information about the navigation history, what product/service is selected and several suggestions. The communication session is established and the sales agent's virtual assistant provides with demo films and booklets, statistics or other information.

Fig. 6. Live customer service

The multimedia capabilities increase the efficiency of the sales process and help the sales agent to easily do the own job. The customer also receives not just the information from the sales agent but he/she can also view the selected product/service in different situations according to the demo films, how it works or state conditions and parameters it reaches during the lifecycle.

3.7 Technical support

The technical support scenario is based on the call center concept: the service engineer helps the customer to fix a problem with a product/service the customer bought from the virtual store. If talking about a software product/service, the customer is able to shared his/her desktop and allow the service engineer to remotely manage the situation. The product/service can contain a control panel that allows the service engineer to remotely access it. If talking about another type of product, for example, the service engineer can use the web cam from the customer's machine and see what happened to the product, in that case a video camera.
There are situations when the service engineer meets problems when assisting the customer and must invite one of his/her colleagues to the video communication session. That way the collaborative session will allow the third attendee to connect and share the communication channel and resources.

4. Low cost computer-supported collaborative learning prototype

A lot of research has been done in the field of learning processes and learning activities. This has resulted in various theories such as cognitive learning theories, constructivist theories, and social-historic theories. (Shaozi et al., 2003) demonstrated that each of these theories is associated with a number of specific design principles and prescriptions. In parallel to the development of theories there was also an explosion of network-based technologies, mainly Internet and Web-based, enabling traditional and non-traditional distance learning approaches. Most of the developments have been learner and teacher centered. Group centered designs consider that learning is achieved through constructivism and collaboration.

Due to the changing nature of work and study under knowledge-based economy of this century, as society participants, the teachers and students need to develop ways to deal with complex issues that require new kind of knowledge. (Tan & Chan, 2008) presented the students and teachers to work, collaborate and learn new things from a variety of resources and people, to investigate questions and bring their learning back to their dynamic learning communities. The number of learning communities grows up but just some of them have the expected success. Often new collaboration tools focus on a specific solution or collaboration task only, without considering the integration of this process into a large but easy to use and very suggestive environment. Moreover, new collaboration technologies require a change in human interaction. Thus the uptake is mainly driven by the benefit. If users do not experience an immediate personal benefit new applications are not applied even if the new tools are properly introduced and training.

Leaded by social and technological problems in the third generation of E-Learning systems the authors propose a low cost prototype based on a Web 2.0 Collaboration Architecture that provides the teachers and students with educational services in different domains such as mathematics, physics, engineering, social sciences or foreign languages. The authors review common groupware problems and reflect the changes in both education and training. The article highlights the Web 2.0 approach in the eService environments, especially eLearning area, it describes the architecture proposed adapted to the requirements of a generic collaborative learning framework that works properly in different domains. It also illustrates how Computer-Supported Collaborative Learning (CSCL) tools improve the knowledge building process and what kind of solutions the designer of a CSCL environment should consider in order to avoid the CSCL weaknesses.

4.1 Fixing problems in CSCL environments

(Williams & Roberts, 2002) illustrated strengths and weaknesses of the computer-supported collaborative work such as effects on academic stuff, repositioning of the responsibility of learning, educational content, interaction time management, communication application of workplace skills, computer competency, or class geography and size. After some years when both hardware and software technologies are more powerful and stable, there are still problems when talking about the collaborative tools in education and training and they have different causes. The prototype allows the E-Learning services providers to fix a list of problems in computer-supported collaborative learning area. It can be easily adapted to the requirements in the fields of primary and secondary education but it is focused on challenges of virtual universities and professional training.

4.2 Issues regarding the academic staff

The educational process is conducted by teachers without experience with many of the CSCL techniques, neither blended learning capabilities, they did not have any training in delivering collaborative classes via a computer and they do not realize that sometime they have been collaborating between themselves by the use of the emails, ISLs and phone conversations between lecturers and faculties. The proposal highlights both user- and group-centered learning concepts that allow the teachers to prepare the educational content to be shared between students and schedule/conduct the virtual classroom sessions and the students to actively participate to the educational process. The framework is designed using the Web 2.0 principles, so, the application should be easy-to-use, the graphic components are simple but very suggestive and comprehensive and the server-side components are powerful, affordable and stable. There are four main features that characterize the Web 2.0 applications and the authors focused on these when proposing the system architecture. These four features just match with social software application problems: *Decentralization* – as a consequence of being a real network. Each node has the ability to act as emitter and receptor of information; *Openness* – using standards in communication, free licenses on content, promotes collaboration; *Dynamic* – applications are developed and deployed quickly. User suggestions are attended and supported; *User orientation* – easier and better user interfaces facilitates participation.

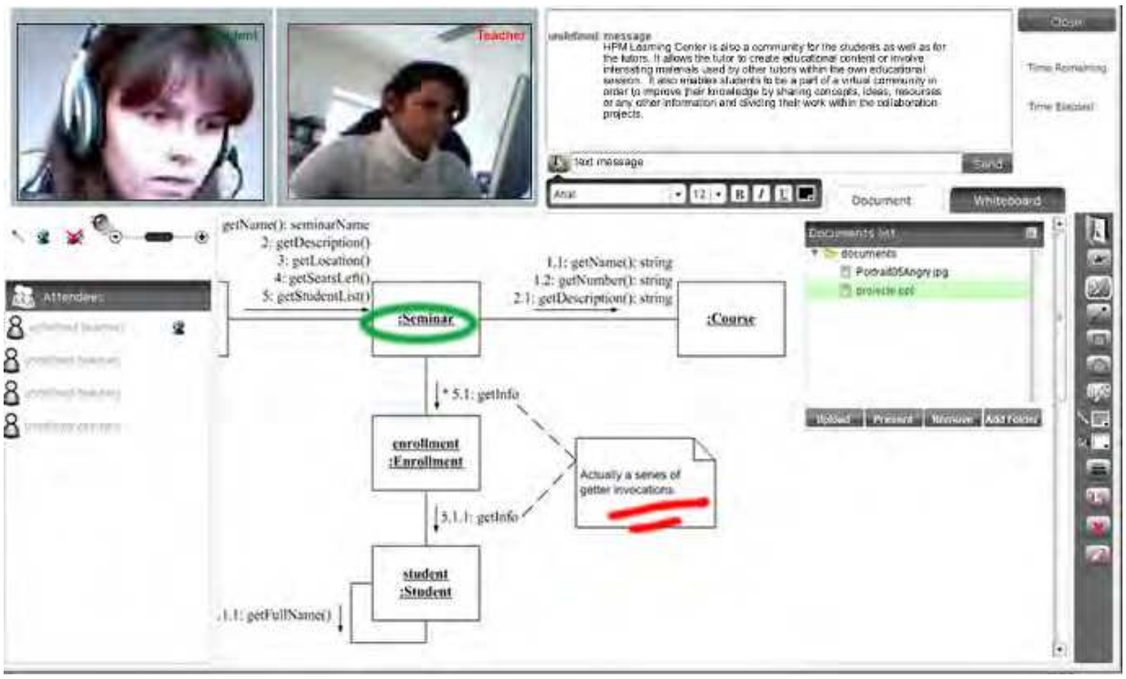

Fig. 7. Collaborative Tool. Teacher module

The system architect included to those Web 2.0 advantages other important aspects that help the teacher within the educational process. The teacher always prefers to present to the class the own materials such as scanned copies of notes, Word/RTF/PDF documents, PPT presentations, even web resources. The prototype allows the teacher to schedule the collaborative session, prepare the content for the class by updating the media library, start

the class and share the educational content with all the students attending the session. Usually, the teacher needs annotations for explaining more about the content and that aspect is considered as an important feature. The virtual shared space consists of two different tabs, document and whiteboard. The first one allows the teacher to share the resources with the students and make annotations on the document surface using the handwriting capabilities, drawing lines/circles/rectangles or adding text boxes). The whiteboard looks like an empty white page used by the teacher when adding more explanations to the educational material. The whiteboard can be also used in a collaborative session if the teacher decides to lively assess the knowledge of the class by enabling one of the students to have the whiteboard control for a short exercise. The figure 2 illustrates the functionalities implemented by the teacher module.

4.3 Responsibilities of learning

The traditional education system as encouraging competition and individual responsibility between students and discourages any interaction, whereas the collaborative learning environments redefine the relationship between students and teachers by creating a supporting environment versus a competitive one. In the traditional system the teacher presents the course materials to the class but the asynchronous collaboration transfers the lecturer's role to that of facilitator and resource guide as CSCL requires that the student takes a more active role in his/her own learning.

The proposed technology supports both traditional and collaborative learning and combines those two concepts in order to allow the teacher to make face-to-face presentations of the educational materials (video communication link and annotation tools), to have full control of the class, monitor students, control project activities (project teams monitoring), etc. The framework also allows the student to actively participate to the course presentation, communicate to the teacher in a real-time manner and collaborate with his/her colleagues for achieving the project goals. An intelligent component dynamically controls the system configuration, elaborates the statistics and analytical reports, bandwidth measurements, server overloading or media library setup.

4.4 Educational content

Many of the current handbooks and textbooks are not designed to promote group activities and provide minimal suggestions on how to promote these activities, although a few publishers are now tailoring their books to cater at least partially for collaborated work. CSCL techniques still require the formulation of handouts but these handouts are designed more to create a relationship among the students and provide a basis for them to work together. Since there is very little supporting information, the lecturers themselves may often have to develop this information in the forms of worksheets and any other appropriate materials.

The system architect considers the lecturer's effort and designs a complementary tool that allows the lecturer to dynamically handle the educational content. Two types of educational content are stored into the E-Learning platform: public and private content. If the tutor considers one of his/her materials as really important for the public interest, that material will be uploaded on the server, convert to an internal format (slideshow, e.g.) and stored into the media library as a public material. If the material is private or the tutor has no rights

to make it public, it will be converted to the slideshow format and then stored into the media library as private. The tutor is able to browse the media library, load it on the shared space (whiteboard) and share it between the students during the educational session. The content is presented within the document surface as in the original editor, see the Figure 2, and both teacher and active student can use the scrolling bar for browsing it, if necessary. The scrolling action automatically generates updates of the remote shared objects and the result is displayed on the document surface of every instance of the virtual shared space, so, it can be viewed by all the participants to the collaborative session.

4.5 Interaction and integration

One of the major components of CSCL is the interaction that takes place between students. Teamwork is vital to a successful CSCL environment. The interactivity that takes place such as the giving and receiving of help and feedback, the exchanging of resources and information and being able to challenge and encourage other students is materialized in many research studies elaborated in the last years. There are four main types of interaction: interaction with resources, interaction with teachers, interaction with peers and interaction with both teacher and learner through an interface.

The prototype supports the interactive learning concept and highlights the aspects related to the web presence, "face-to-face" interaction, real-time collaboration, knowledge sharing and multimodal interactivity. Technically, the web presence is illustrated in the student list where all the students registered to the course appear, each one with his/her status (off/online), "face-to-face" interaction happens when the student and lecturer share opinions using the virtual classroom tool, real-time collaboration and knowledge sharing means that tutor and learners share educational content via virtual shared space component and interact with the system that supports drawing and handwriting capabilities. The collaborative session is stored in a multimedia format and the attendees are able to review the educational process using the media on demand functionalities. Interacting with the resources is an important feature when talking about collaborative learning in foreign language. Here, the learners need dictionary or text-to-speech capabilities. The framework allows the student to access five languages dictionaries (English, French, Italian, Portuguese and German) and the TTS component is integrated with the vocabulary and dictionary components see the Figure 8. That way, learners can easily translate words from a language to another one and then render the correct pronunciation in the speakers.

These features help the learner to improve the pronunciation and the communication skills. Drawing and handwriting functionalities make the virtual tool closer to the real teaching process, they allow the tutor to present the educational content like he/she does in the classroom. A project section is developed in order to allow the students to work as a team during the project development period of time. The project supervisor monitors and controls the project development, views the students' activities and provides each student with an objective feedback based on the student's performed tasks.

Fig. 8. Student Module – Dictionary and Text-to-Speech Components

Teaching signal processing courses, as (Ambikairajah et al., 2007) illustrated, at any level presents challenges in conveying complex mathematical concepts, retaining the students' attention, and addressing individual student needs in a large classroom, so, only a small percentage of students are able to grasp the key concepts at the time of the live lecture delivery. The other students have to understand the topics presented in their own time and with whatever assistance is available. That way, the recording of rich multimedia information combining video and lecture or dynamically annotated tutorial slides can be used to improve self-directed student learning and offer new possibilities for course delivery. In practice, most annotations serve as attention marks, providing critical linkage between the slide content and spoken context.

The prototype should be able to integrate advanced teaching technologies such as interactive whiteboards, tablet PCs, digital tablet pens, video projectors, etc. within a stable and powerful educational environment that supports blended learning services. The teacher is able to manage the educational process using two different components integrated each other. The virtual classroom component enables the teacher to remotely conduct the class and the whiteboard component that allows the lecturer to present the educational content in a traditional way. The students can opt for both learning services being in the classroom to be able to lively attend the teacher's exposure or to virtually participate to the learning process via web.

5 Virtual Medical Community

Each physician can share the knowledge and experience with other colleagues in the own country or abroad and the proposed telecommunication infrastructure provides with real advantages in that way. The physician in a small hospital or medical studio that investigates a patient can meet difficulties and he/she needs a specialist's opinion (the opinion of his/her professor in the university or even the opinion of his/her colleague from another department) before the conclusion. The young physician on guard has to investigate an unusual case and he/she needs the opinion of his/her professor/head of department but a simple phone call is not enough for offering all the medical information related to the patient.
The multimedia capabilities allow the physicians to build their virtual community as a subnet where the friends and colleagues with the same interests share ideas, concepts, methodologies and experiences or cases in an interactive manner. For example, the live streaming from the echograph when diagnosing the patient can be shared between the physicians in order to increase the investigation efficiency. Video telephony online focus group functionalities are implemented for improving the communication capabilities.

5.1 Physician's point of view

The physicians use the interactive environment as a simple tool not a sophisticated one. The physician is focused on the patient not on the interactive tool. He/she needs the communication tool if meeting a strange case, the physician is in crisis and the patient can be scared. For that reason, the communication has to be transparent but not scaring the patient. The communication sessions between the physicians can be realized in the front of the patient or not and the system must support both of the video capture and live streaming capabilities. When the physician seems to have problems when diagnosing the patient, the video capture component will be used. The system captures the video data from the S-Video output of the echograph and stores the data on the media server. The video capture will be shared within the communication session (on the shared space) between the physicians but the specialist can ask the physician for a new echography and the live streaming component will be used.

5.2 Specialist's point of view

The specialist can be located in the same hospital the physician performs his/her activity, in another hospital, in the university, at home, or abroad. The specialist is notified by the system about one colleague/friend in his/her community requires assistance. The notification can be via email or SMS if the specialist is off-line or using the internal messaging if he/she is on-line. The specialist can access the system using the PC or Pocket PC and he/she can also invite another specialist to assist if necessary. When assisting the physician, the specialist asks for the video sequence captured from the echograph. If this video sequence is not enough for the diagnosis a new echography can be done. That way the specialist seems to remotely investigate the patient asking him/her a few details about his/her status during the live echography. After the new echography the physicians can share the captured video sequences of the new echography and shared their opinions. When the specialist is not in the front of his/her PC and accesses the system via GSM/UMTS/WLAN network the Pocket PC is used. The quality of the new echography

will not be the best one and sometimes the specialist cannot grant his/her solution is the best because of the live video streaming quality: view component for the Pocket PCs is 240 x 240 pixels and the details are not visible. The opinion of another specialist is helpful in this kind of situations and the small group meeting component allows the physicians to communicate and exchange information in an interactive manner.

5.3 Multimedia capabilitie within the virtual medical community

The physician meets the problem when diagnosing the patient, launch the application, connect the echograph to the client module and record the video sequences of the echography. The client block dynamically setup the video capture parameters according to the bandwidth between the client and server machines and starts capturing till the end of the echography. At the end of the echography, the physician is able to review the frame sequence, mark the important zones using the marker or the handwriting and save the media file on the server.

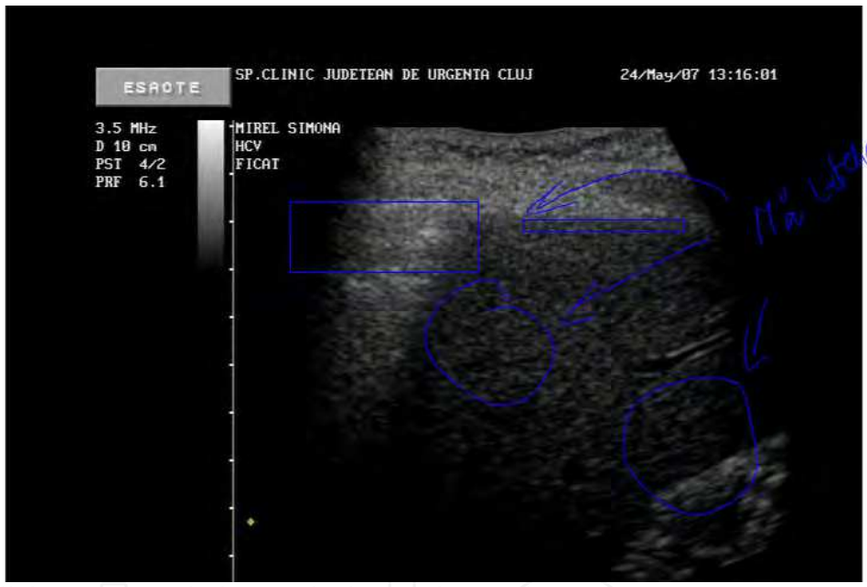

Fig. 9. Collaborative work during the liver echography

The *remote shared objects* concept is used in order to implement the shared space component. One client component in the system changes a property of its copy of an remote shared object, the updates are sent automatically to all the other client blocks sharing the same object.

6 Advances in Administrative and Security Services using Collaborative Tools

The prototype highlights the most important advantages of a heterogeneous telecommunication system designed for improving the administrative and security services by using the media capabilities such as collaborative work, image and video capture from the mobile devices, server-side real-time collaboration, media content retrieving and

delivery. The concept proposes some of the most popular technologies for implementing the client- and server-side components of a simple but very useful collaborative work environment: Java/J2ME, Adobe and PHP technologies.
The collaborative tools are dedicated to the administrative and security domains and allow the end-users to synchronously/asynchronously communicate each other or in group for achieving their goals (find solutions for complex situations). As a short scenario, the security agent in area takes photo(s), using the mobile phone and the media content will be automatically uploaded on the media server. The person in charge is notified about a possible problem in area, so, the system allows him/her to have a real image of what is happening there providing with new elements (images or video sequences) accessible from the media library. If necessary, the person in charge can contact the commander for a suggestion/solution related to the situation illustrated by real images/video sequences. The digital resources stored into the virtual library are editable, that way the person in charge can easily confirm with the solution just annotating the part of the image/video frame being interesting. The system automatically sends the marked picture back to the agent in area in order to help him/her for taking the correct decision.

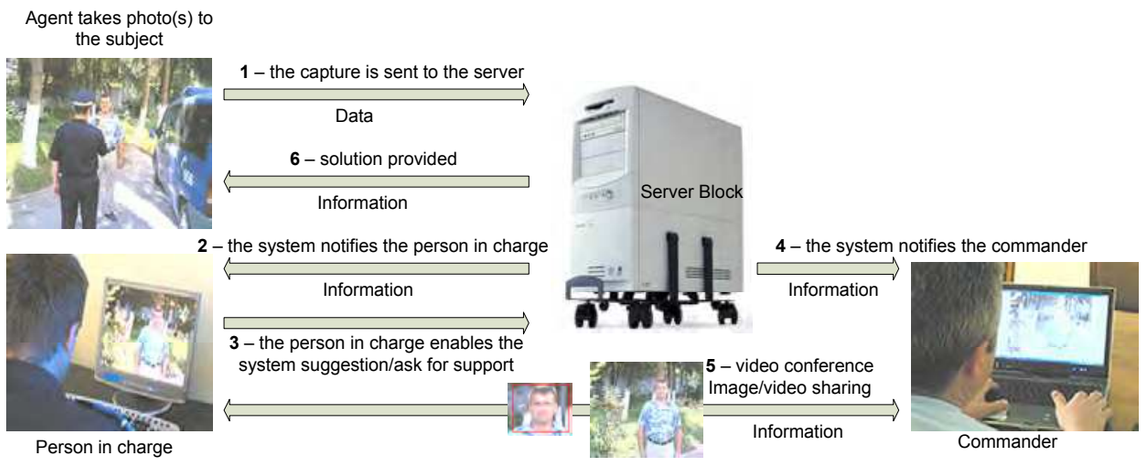

Fig. 10. Collaborative tools in administrative and security areas. Flow chart.

The multi-channel access is considered the only one solution for implementing the functionalities described in the scenarios from the *Introduction*. The explanation is very simple: the agent in the area uses the mobile device in order to communicate to headquarter and the persons in charge has to share the processing results using the web browser, a desktop application or a mobile device.
This heterogeneous system involves some of the most popular technologies: J2ME for the mobile area, PHP and Flash for the web components, MySQL as the database server. In fact, the authors have been constrained to use those technologies that offer the following advantages: J2ME MMAPI/AMMS API provides the developer with video capture capabilities and MIDP I/O package offers networking features that extend the resources available on a network into the mobile space; PHP components implement the tool management, the authentication functionalities and invoke the processing block; Flash offers excellent multimedia capabilities: 2D shared graphics, audio/video support, etc.

6.1 MIDP-based client application

The agent has to prove the situation to headquarter by taking photos and recording short video sequences related to the status in area. When using a mobile device, the agent, in different situations, has the advantages of the mobility and real-time processing. The MIDP-based client application must assure an image/video quality necessary for the processing but it is also responsible for the data communication - the best quality of the video sequence or image means big amount of data transmitted via GPRS/EDGE. This fact will be avoided and, for the first stage, the image snapshot will be realized using a normal resolution about 640x480 pixels. That way, the upload is done in some seconds and the space allocated into the media library will be about 50 KB. More, if trying to record a video sequence related to the situation in area, the agent will actually take snapshots about 1 frame per second and the application automatically uploads them onto the server. The server-side components receive the frames, one by one, and then put them together as a video sequence at 1 fps. The system architect opted for that approach because a video sequence at 320x240 is not relevant and a bigger resolution means big amount of data impossible to upload in real time.
From the users' point of view, the system is transparent – the agent takes the snapshots and presses the button OK, then puts the mobile device in his/her pocket and waits for the feedback. In fact, the client application manages the data transmission until receiving the acknowledgement. An *HTTPConnection* instance will be used for opening a connection to the PHP upload component and sends the data packets.

6.2 Advantages of the proposed solution

The prototype provides with the following advantages. An asynchronous communication link is established between the headquarter and the agent in area. That way the agent is able to illustrate a real image of the situation created. The agents have the video control and monitoring of important objectives and the multimedia insformation illustrating the real image of the objectives can be stored into the virtual library. The decision making is easier to be realized when the headquarter has a real image of a special situation in area without going there and losing time. The system supports low cost equipments (normal mobile devices, web cams and headsets) and provides with high quality of work (high results/investments report). The telecommunication infrastructure respects a low cost architecture: normal internet connection and workstations/laptops for accessing the services via web and GPRS/EDGE mobile devices for the mobile area. Virtual library contains proofs that consist of authentication elements and the time they have been realized. All of those can be used for future researches, if necessary.

7. Conclusion

In the context of the crisis and time and cost constrains, teleconferencing and web-based meetings increased with 40% but the travel costs decreases with 31%, in the last months, accoding to the IEEE Spectrum , February 2009. So, there are interests in using collaborative tools but the technology is not very friendly. More, the professional conferencing systems (POLYCOM, e.g.) are really expensive but limited. The limitations especially regard the service access – the end-user needs a conference room, TV/access equipments in each access place, etc. Other issues are related to the resource sharing because usually the conferencing attendees are talking about real aspects such as management issues, marketing aspects,

commerce (negotiation) problems, so the resource sharing capabilities are very important. The developers need a generic framework that allows them to easily build the own collaborative environment and customize it according to the domain rules.
The presented framework is dedicated to the business, education and administrative/security domains and enables the web masters to integrate the collaborative tools within the own web portals and sites as widgets. It helps the E-Service providers to fix a set of issues met in the different domains such as: IT&C experience, time management, responsibilities in E-Services, interaction or interactivity. The goals for real-time collaboration technologies are straightforward, for that reason, the authors must add some other important aspects to the ones already enumerated.
As described in detail in that chapter, Internet-Supported Collaborative Work solutions must be affordable, available, scalable, supportable, and manageable.
Affordable: Real-time collaboration total cost ownership (TCO) tends to exceed projections due to the high costs of maintaining a globally accessible real-time communications infrastructure. Linux offers a really high uptime and the system components work properly on a Linux server machine. In conclusion, the framework can be considered affordable.
Available: The TCO of real-time collaboration must include the cost of downtime. As virtual collaboration becomes more strategic to the business, educational, or administrative processes, the cost of downtime increases. A cost effective collaboration solution must therefore be highly available.
Scalable and high-performance: The end-users increasingly demand sophisticated real-time collaboration functions such as rich multimedia. These video/ voice/data requirements, coupled with performance and reliability challenges posed by the variability of Internet access (including dial-up links, ISDN, Wi-Fi, satellite, and other bottlenecks) and the need to support large numbers of attendees, place stringent architectural requirements on collaboration solutions. The novel methods of virtual collaboration discussed in that chapter have gained excellent acceptance from attendees and have shown potential for increasing their understanding beyond the level provided by traditional methods.

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