

E-learning Environment for Deaf people in the E-Commerce and New Technologies Sector

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Abstract: - In this paper we present the creation of a distance and life-long training Environment for the deaf people in the e-commerce and new technologies sector via e-learning tools. The resources will feed the development of a multi-language platform within Leonardo framework (DELFE project) for supporting e-learning in Greek Sign Language (GSL). The basic objective of the project is the support of the equal rights of Deaf people for their access and real attendance in the professional training. The final aim is the creation of a passage for these individuals into the new professional fields via their training with specialized knowledge and dexterities in the use of the continuously developing sectors of e-learning and electronic Trade (e-commerce). The e-Learning environment for the Deaf People is adapted to their capabilities and communication abilities via the Sign Language. The environment is based on the usage of the advanced teleconference services of Internet (network virtual classroom) and offers a sum of facilities and services that are able to support, via an easy and friendly way, education and training in the form of life long and continuing education for the Deaf People.

Key-Words: - e-learning, deaf people, sign language, videoconference, traffic network, e-commerce

1.1 Introduction

It is a common remark among the professional in the fields of special education, that despite of the tremendous evolution of computer communication networks and especially Internet services and facilities, little has been done towards the direction of usage and penetration of these network services within the domain of education - training and mainly within the sub domains of life long training, continuing vocational training and distance training for the Deaf People. Primary target user group are the deaf pupils who need e-learning tools and educational material for the e-Commerce and new technologies sector. Till very recently e-learning systems were unavailable to students with hearing impairments. The basic cause of the current state is the lack of material translated into the Sign Language as well as the lack of dexterities in the use of tools of e-learning technology by hearing impaired people. However, the user-friendly multimedia based, telecommunication and the information services of the Internet can be used as a standard electronic platform to support primarily the main procedures of distance, life long and continuing training for the Deaf people. The set of the telecommunication and information services, adjusted to their special needs via the means of the Sign Language, and this is a certain method towards

the general improvement of the educational and training services provided for the Deaf People.

Formal teaching of GSL as a first language from the very early school years, and relevant development of educational content is becoming very urgent since law 2817/2000 was put into action by the Hellenic State. This law defines that «the official school language of deaf and hard hearing students is the Greek Sign Language» and that «knowledge of the Greek Sign Language is a prerequisite for the positioning of tutors and special education staff at the schools that host deaf and hard hearing students». In this context the new education programs of the Pedagogical Institute require that all educational material, which will be produced from now on, must be accessible to the deaf students through the use of the Greek Sign Language [1].

The basic objective of the project DELFE (Leonardo Da Vinci) [2] is the support of the equal rights of Deaf people for their access and real attendance in the professional training. The final aim is the creation of a passage for these individuals into the new professional fields via their training with specialized knowledge and dexterities in the use of the continuously developing sectors of e-learning and electronic Trade (e-commerce). These

knowledge and experience will constitute supplies for their life long training and education.

Specifically, in the sectors of e-learning and e-commerce, an important blossoming in the work market is observed and new places of work in the enterprising sector are continuously created. Consequently, the target group (Deaf people), that faces problems of social exclusion and unemployment, will have multiple profits from the pilot action of distance and long life training into the new tools of society of information.

We point out that the quality of the educational material that has been produced as well as the methodology of training that has been applied in the pilot work, is ensured by the attendance of experienced scientific personnel of special education, special scientists and engineers of information technology that have participated repeatedly in inquiring European programs of distance education and education of Individuals with Special Needs.

1.2 Greek Sign Language – the background

Greek Sign Language (GSL) is a natural visual language used by the members of the Greek Deaf Community with several thousands of native or non-native signers. Research on the grammar of GSL per se is limited; some work has been done on individual aspects of its syntax negation [3], morphology [4], as well as on applied and educational linguistics. It is assumed that GSL as we now know it is a combination of the older type of Greek sign language dialects with French sign language influence [5]. Comparison of core vocabulary lists exhibit many similarities with sign languages of neighboring countries, while in morphosyntax GSL shares the same cross-linguistic tendencies as many other well analysed sign languages [6]. GSL has developed in a social and linguistic context similar to most other sign languages [7]. It is used widely in the Greek deaf community and the estimation for GSL users is about 40,600 (1986 surveys of Gallaudet Univ.). There is also a large number of hearing non-native signers of GSL, mainly students of GSL and families of deaf people. Although the exact number of hearing students of GSL in Greece is unknown, records of the Greek Federation of the Deaf (GFD) show that, in the year 2003 about 300 people were registered for classes of GSL as a second language. The recent increase of mainstreamed deaf students in education, as well as the population of deaf

students scattered in other institutions, minor town units for the deaf and private tuition may well double the total number of secondary and potential sign language users. Official settings where GSL is being used include 11 Deaf clubs in Greek urban centers and a total of 14 Deaf primary, secondary and tertiary educational settings.

1.3 Internet accessible research background in the area of sign languages

The internet has proven to be a boon for people with disabilities. But just as it is important to design buildings with accessibility in mind, the same is true for the internet. Flexibility is the key to accessibility. It's important to keep in mind that people will be using a variety of technologies to access your home page. Keeping your page accessible mean keeping such options open. In an age of intelligent HTTP/WWW servers that can query clients about their feature-lists [8].

The choice of the technical advanced video in the e-learning system plays important role. Video technologies offer great possibilities for better telecommunications for deaf people who use sign language as first language. When selecting or developing systems for communication in sign language, a method is needed for determining the usefulness of a given system. Video communications offer great possibilities for better telecommunications for deaf people.

But sign language places great demands on the moving image. Many video conference systems currently installed are of a quality that is insufficient for sign language. When selecting or developing systems for communication in sign language, a method was needed to determine the usefulness of our system.[9]

At the web site of World Wide Web Consortium (W3C) we drew useful information that has to do with the creation accessible html pages for the deaf and half hearing persons. For any time-based multimedia presentation, synchronize equivalent alternatives with the presentation. A time-based presentation can include any form of multimedia, such as a movie, animation or slide show. Equivalent alternatives to these types of presentations are captions (which provide access to audio tracks) and audio descriptions (which provide access to visual tracks). They have already explained the need to provide a textual transcript for any audio track or video track, and a textual description of the video track. However, it must be

admitted that a text transcript alone is not the ideal method for providing an equitable experience for persons with disabilities. It is widely accepted that on-screen captioning allows deaf and hard-of-hearing people to more fully appreciate the experience of a movie or multimedia production. A separate textual transcript that must be read after the fact does not provide an equivalent experience.

The caption track is an alternative method for deaf or hearing-impaired viewers. Synchronizing this alternative with the main presentation means that nearly all users will get the best experience and the most information available to them. [10]

In a recent work titled "Sign Language Europe" [11] they have developed a software environment (ITOM, figure 1) that makes School-TV broadcasts (or other movies) accessible in two languages; 1. in Dutch by sound and subtitles 2. in Dutch sign language. At the moment they use the ITOM with school-TV broadcast from Dutch school-TV broadcaster Teleac, but ITOM can be used for every video program available. Because ITOM is an open structure and it is even possible to put in any other content. If necessary the screen layout can be adapted for special content. At the moment the ITOM offers different possibilities to view a video program. 1. You can view the original program with subtitles. 2. You can view a sign language narrator with still pictures from the original program. We cut down the original program in small fragments and all these fragment are direct accessible in Dutch and in Dutch Sign language. 3. Sometimes you find additional information to a fragment of the program. This information is available in written Dutch and in Dutch sign language. 4. Often we add self-test questions to a fragment in written Dutch and in Dutch Sign language.

The Sign language version provides a version of the story in real sign language. Beside the sign language narrator you see still pictures from the video program. They choose still pictures because moving pictures beside each other are hard to follow. You can watch the version with subtitles for the moving pictures. At the moment we are experimenting with the use of an interpreter for the sign language version. The ITOM uses an HTML browser with a Real player plug-in (version 8 or higher). The ITOM will also play from a CD-rom, (but older CD-rom drives will not play the video fluently).



figure 1

1.4 The project's language resources

Implementation of both the e-material and e-learning tools of the platform require collection of extensive electronic language resources for GSL as regards the lexicon and the structural rules of the language. The actual data of the study are based on basic research on GSL analysis undertaken since 1999 as well as on experience gained by projects NOEMA [12]. The data consist of digitized language productions of deaf native GSL signers and of the existing databases of bilingual GSL dictionaries, triangulated with the participation of deaf GSL signers in focus group discussions. The project follows methodological principles on data collection and analysis suitable to the minority status of GSL. Wherever the status of individual GSL signs is in consideration, the Greek Federation of the Deaf is advised upon, too. Many of the grammar rules of GSL are derived from the analysis of a digital corpus that has been created by videotaping native signers in a discussion situation or when performing a narration. This procedure is required because there exists little previous analysis of GSL as a natural language. The basic design of the system, except for the educational content this currently supports, focuses on the ability to generate sign phrases, which respect the GSL grammar rules in a degree of accuracy that allows them to be recognised by native signers as correct utterances of the language.

In this respect DELFE offers a great challenge for in-depth work on both directions, lexicography and linguistic analysis of GSL; for the first time research will go beyond a mere collection of glosses [13] and move further from many previous bilingual dictionaries of sign languages [14], into the domain of productive lexicon [15], i.e. the possibility of collection new GSL lemmas and GSL corpus in the domain of e-commerce and new technologies sector. It is a design prerequisite that the elearning system of GSL should have an open design, so that it may be easily extendible allowing additions of lemmas and more complicate corpus. From a linguistic point of view the resulting database of glosses, rules and

tendencies of GSL will be a significant by-product of the project, of great value to future applications.

2.1 Description of the e-learning system

The basic objective of the project *DELFE* is the support of the equal rights of Deaf people for their access and real attendance in the professional training. The final aim is the creation of a passage for these individuals into the new professional fields via their training with specialised knowledge and dexterities in the use of the continuously developing sectors of e-learning and electronic Trade (e-commerce). Indisputably, these knowledge and experience will constitute supplies for their life long training and education.

In the present paper, we intend to describe the following:

a) An e-Learning environment for the Deaf People adapted to them via the Sign Language. The environment will be based on the usage of the advanced teleconference services of Internet (network virtual classroom) and will offer a sum of facilities and services that will be able to support, via an easy and friendly way, education and training in the form of life long and continuing education for the Deaf People.

b) the electronic informative “adaptive” material for Deaf People in the form of Web is included. This informative material will be based on animation (flash technology) and streaming video (multimedia) and will be directed towards the aim of training in e-commerce and new technologies of Internet. The material will be all translated in the Sign Language via the Streaming Digital Video.

c) Furthermore, the web portal and a human network (forum) of educators, technicians and educators within the scientific domain of deaf people, is also within the central goals of the present proposal. The portal together with the human network will undertake the role of the information circulator from and to professional and deaf students. These means, via specific actions, will inform the professional and students for new products. Moreover, it will bear the feedback and demands from deaf community (students, professional) to industry.

2.2 Methodology

Firstly we must point out that the innovation of the pilot project *delfe* lies in the fact that for first time it was attempted an effort of distance courses, continues and life long training for the people with hearing problems. Moreover, the “special material”

was materialised with the help of special educators dealing with the individuals with hearing problems while it will exist network “forum” (human net) where scientists, technicians and

producers of products have undertaken the role of giving information in the scientific field of special education and distance education (e-learning).

The team of development of *DELFE* followed the modern practices for the planning and the produce of the final system of system. The total work was separated in the following sub systems, there are: 1) Production of educational material of distance training in the Sign language, 2) Telecommunications and Network creation, 3) Network electronic environment (Network Virtual Classroom) that will support the tele-education – tele-training for the “special” team with aim in the Sign Language of each country – institution, 4) Network gate of information (Portal) and human net (forum) and 5) Pilot action of distance training. For each sub system it was supported in the following line of distinguishable stages for each sub system: a) Research for the state of art of the sub system, v) Determination of the requirements of users, analysis of the present situation, c) Syntax of specifications of sub system, d) Research - Study - Planning of sub system, e) Concretisation of sub system and z) Trials of smooth operation, isolation of problems and improvements.

At this time that the work is written we are in the test stage and expect from the final users observations and further corrections of the final system.

2.3 Research

At the stage of research in the frames of determination of the system’s specifications but also of the electronic material of learning we judged that is essential to create questionnaires, that we shared in the participating institutions. Our purpose was to acquire the general level, of the community of deaf people in the new technologies. As well as to learn the way of access, that the Deaf people wish, in the electronic information.

3.1 Presentation of e-Learning platform for the deaf

The environment of *delfe* will use asynchronous services of delivery of the educational material and modern and asynchronous services of communication and collaboration, trying to exceed the exclusions that are related with the time and the place of training but also to satisfy the needs of deaf students with variety of possibilities of equipment

and communication.

The model of visual classroom will be applied with use of services of videoconference via picture, at the same time with the possibility of realisation of cooperative activities of real time (whiteboard, application sharing, file sharing).

Apart from the model of visual classroom will also exist the model of Supported Self learning. A basic rule that should condition the systems of tele-education for self learning, is the control. This means that the educated person will be simultaneously able to use the course but also to intervene in the flow and his structure. In this model the strategy is learner centred.

The services that are provided by the environment are categorized in four fundamental axes:

-Visual order: line of courses in real time with possibility of interaction via internet.

-Self-instruction: access (search and recuperation) in training and informative material for various cognitive and more general subjects that interest teachers.

-Cooperative learning: communication and attendance in thematic circles of discussions and development of cooperative activities. Telework: it will provide the possibility of distance entrusting and planning of work.

3. 2 support of the end user

The users of environment of training are distinguished in three categories:

The administrator of environment, that is unique per institution. The particular user has the responsibility of good operation of environment and the import or the deletion of users.

The presenters/teachers that are unique in level of presentation of seminar /training programs. Each presenter/teacher has the responsibility of one or more programs and its management.

Participating/trained that have access in the training material and can express their intention of registration in programs of training or their deletion from them in the administrator of environment.

In the completed perception of work one can distinguish three main entities:

- Presenter/Teacher
- Participating/Trained
- Educational material

The electronic environment is useful in the process as a supporting system that allows the interconnection via the internet of all the previous entities.

The processes that are distinguished concern the two main levels.

3.3 description of e-learning process

The analysis of needs and the description of services that is provided are impressed in three phases of educational process:

Preparation of visual class. (Asynchronous phase) Activities

Planning and parameterizations of interactive environment of courses via the internet with the use of special program of Reader of Web pages (Web Browser). The complete material of courses of distance education will be stored in a local or removed (network) base from where the user might draw the information according to planning of environment of the distance education. Also the possibility of communicating with experts and announcing the course and the availability of material will be given to the instructor. In the educated persons it gives the possibility of studying in first phase the under representation material and of submitting the first questions.

Operation of visual order (Modern phase) Activities

At the duration of course the professor via the system of videoconference, multipoint video/audio, via text chat, shared whiteboards, web based pre-, post -, in class interactive program of interpellations, presents the material and the educated participate actively and can collaborate at teams. Also the system via network refers the educated in additional material. Also all the process is recorded for future report by the instructor but also by educated.

Processes of modern communication between teacher and trained but also between trained:

Operation of review (Asynchronous phase / Post - class) Activities

The review of class concerns the part of activity as the modern phase of visual class is completed. Naturally it can have a lot of phases at units and courses. The material that has been already presented in the visual order will be accessible. There will be questions of understanding the course, multiple test, so as to be a complete picture of progress of understanding the course from the educated.

Self - education (Asynchronous phase)

Preparation og the Self-education.

The self- education is totally found in asynchronous phase. The educated will have access (search and recuperation) in training and informative material, connected with the base of material, for various

cognitive and more general subjects that interest him. Thus we use all the possibilities of visual class that are used in asynchronous phase. We have access (search and recuperation) in training and informative material for various cognitive and more general subjects that interest teachers.

In the follow figure 2 we present the flowchart of the e - learning model and in the figure 3 we present a view of the platform design.

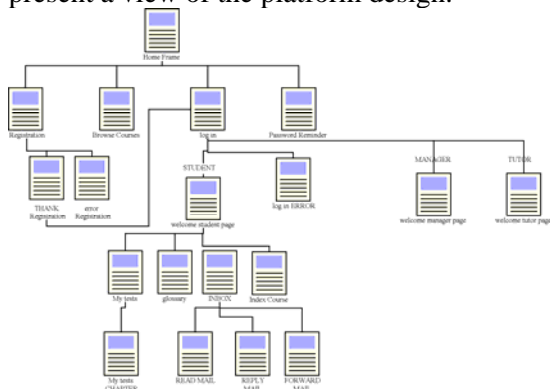


figure 2

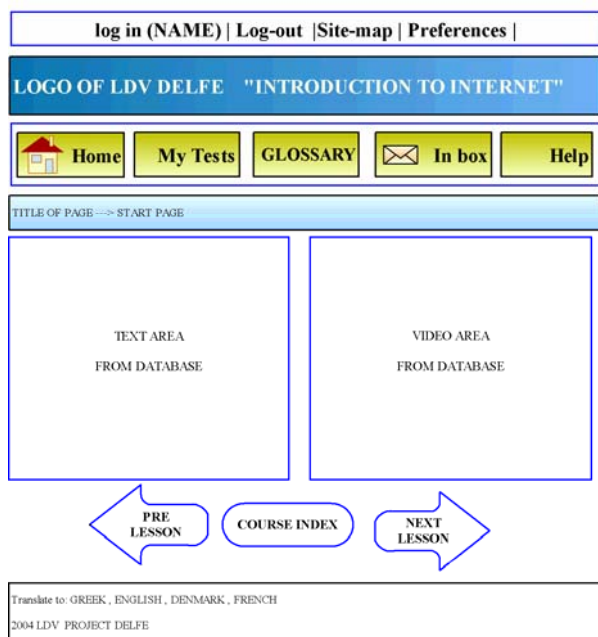


figure 3

3.4. Telecommunications and network infrastructure

In the project DELFE, the networking of institutions between them was based at preference on engaged permanent lines that will interlink the centres in the Internet.

In every case, the institutions that took part in the meetings of videoconference with use of multicasting had telecommunications connections

with capacity of 128Kbps or bigger.

Also for the projection of electronic material that the bigger part was in electronic streaming video a breadth transport above 128 Kbits/sec was essential for the good quality of transmission. While an order of breadth of 356Kbits/sec is considered ideal [16].

Finally, even if the basic network infrastructure of network of DELFE will be based on the Internet and the use of protocol TCP/IP, is likely to present cases where the model with discuss is not feasible, for example, because there isn't the possibility of confrontation of economic cost that is required for the maintenance of permanent network connection. These cases will be faced with the use of connections ISDN/DSL, that provide with small cost the possibility of establishment of connection automatically.

3.5 Videoconference with transmission of pictures

In the work DELFE special software of transmission of picture through the internet was used. This technology is the more complete and impressive form of videoconference. It offers to the deaf people, such as the phonetic videoconference to the hearing people. Using a system of videoconference, removed between them teams of individuals can communicate maintaining optical contact. The particular technology will constitute a basic trunk for our platform and analyses and trials will become for the better quality of transmission of information in the Sign Language.

Apart from the transport of picture and sound, the parcels videoconference usually provide and others adjacent possibilities, as the videoconference via text, shared whiteboard, and generally everything that has been already reported as complementary possibility for the other categories of software of videoconference. The simultaneous use of main operation videoconference with the other possibilities allows the conduct of a complete meeting of intermediate network. In case in deed where the terminals are installed in special rooms with central audiovisual equipment for the comfortable follow-up from a crowd of public, the systems of videoconference is possible to support high requirements mass activities of tele-education, tele- presence or tele- work.

For the project DELFE we used the model of videoconference one to one making use of propagated computational Netmeeting. For the model one to many we used computational class

point of the CuSeeMe. A product enough functional and friendly with enough possibilities of visual order under the form of videoconference.

3.6 Traffic measurements

The research reported in this paper undertook measurements of the IP traffic generated during videoconference sessions (at continuous and switched presence mode) between four vc clients (MS NetMeeting) used by Greek signers (three interpreters and one deaf user). At switched presence mode, the MCU sends to all terminals the output from one participant (QCIF video), designated as "currently active" while at continuous presence, the MCU combines the signal from all terminals and sends back the output to all the participants (CIF video, see figure 4).



figure 4

Concerning the experimental work, two experiments were held at two different high quality (with an acceptable for sign language peak rate equal to 320 KBits/sec) modes of CISCO MCU 3510 (hardware MCU): continuous presence mode - H.261 coding and switched presence mode - H.263 coding (see annex 1, Table 1 for more details). In both cases, to ensure the quality of the sign sequences, MS NetMeeting clients were configured with the same video parameters (High Quality - QCIF). Furthermore, the same sign language Video Contents VC1-4 (signers conversing) were used in both cases for reasons of statistical comparison between H.261 and H.263 traffic.

3.7 material of students –pedagogic process

The material of program DELFE was separated in 3 thematic units. According that many Deaf

particularly in Greece do not know basic rules of internet, as it results from the results of statistical measurements of questionnaires of team of objective, we created the first unit titled the "import in internet". In this unit we prepare the Deaf students for the use of services internet.

We should say that in the work *delfe* we used a different pedagogic process. We taught this unit in the students with a school teacher closely in room of teaching in order to absorb the matter and can learn the basic services of internet. Then we pass in the second unit where we import the students in the basic services of e - learning. The innovation in the pedagogic process is to teach them again "import in this internet" but this time via the platform e - learning of *delfe* using the same material of the first unit but this time in electronic form in the environment *delfe*. With this method we the deaf people familiarized with the new services of e - learning and we advanced faster in the second unit. Then after the Deaf students have familiarized enough with the new e - learning tools we will continue in regular application of environment *delfe* in the Third unit of learning e - commerce. In this moment that the article is written we are in the process of first unit. The second and the third unit will be completed before the end of year 2004. We expect interesting result from their use and application.

As for the technical specifications of material, the material is written as long as it can be in simple language with simple proposals and enough pictures and examples and naturally it is entirely in the Sign Language. The electronic material in form of video is coded in form RealAudio and we use a video embed application player of reproduction of digital video in real video form. In order to see the final user the video have to already put in his computer computational real player [17]. This software is propagated almost and all the computers have already fixed real player.

4. Implications and extensibility of the educational platform

As an educational tool above all, DELFE offers a user-friendly environment for deaf people aged 15 and over so they can have visual translation of words and phrases. The signed feedback acts as a motivating tool for spelling Greek words and structuring sentences correctly, as well for evaluating one's performance. For deaf students as a group with special needs, the platforms draws some of the accessibility barriers, and the possibility of home use even makes it accessible to family, thus

encouraging communication in GSL, but also access to the majority (Greek) language. New written texts can be launched, so DELFE may receive unlimited educational content besides primary school grammar units. On the other hand, unlimited school units, such as the increasing special units with individual deaf students in rural areas and islands can link with one another via DELFE. From a socio-economic point of view, creating this platform will greatly contribute towards the inclusion of deaf people in Greek society in an environment of equal opportunities.

5. Problems and limitations

The main limitations of the study are described below. These are divided into linguistic, educational and technical ones. Most of the limitations are typical to video streaming projects, and they were expected before the beginning of the project. From a linguistic and educational point of view, the major issues that need to be addressed are the following:

- In some areas of the language there are no standardized signs, so there may be some theoretical objections as to the use of particular entries. However, a platform such as the one described allows for multiple translations and have some limitations as to the size of files, as we have to publish these files in the way of streaming video via the web. A second problem is the ability to make changes in the database of video files.
- The data available in GSL, when compared with data from Greek, for example, are dauntingly scarce. Error correction mechanisms were sought after in order to assure reliability of results. Such back-up mechanisms are the use of approved dictionaries, the consultancy of Pedagogical Institute and the feedback from the Deaf Community, along with the continuing data from GSL linguistic research.
- Lastly, all schools in Greece have recently become accessible to the Internet, Deaf settings included. In practice however, there are many more accessibility barriers for a considerable number of deaf students who have additional special needs. Relevant provisions have been made according to general accessibility principles for these students (as to text size, keyboard settings etc) but the pilot application of the after 6 months will certainly indicate more points for development.

Technical problems include:

A qualitative videoconference sign language communication, as indicated by the results of Table 1, is highly expensive in terms of bandwidth. Especially in the case of multipoint continuous presence communication the demand of bandwidth

is multiplied according to the number of the conferring signers. Under these circumstances, DSL links of at least 384Kbps are considered as the minimal requirement for a Sign Language Virtual Classroom.

6. Conclusion

Given that the platform under discussion consists an original research object, successful completion of its development will open the way to a complete support system for the education of the Deaf Community members in Greece.

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Annex 1

Table 1. The experiments' scenarios and some first-order statistical characteristics of the generated frame sequences

<i>Exp</i>	1					2				
<i>Terminal</i>	VC1	VC2	VC3	VC4	MCU	VC1	VC2	VC3	VC4	MCU
<i>Scenario</i>	Continuous Presence - H261					Switched Presence - H263				
<i>Target Video Bit Rate (For Terminals) (KBits/sec)</i>	320					320				
<i>Target Video Bit Rate (For the MCU) (KBits/sec)</i>	1280					320				
<i>Target Frame Rate (fps)</i>	15					15				
<i>Duration (sec)</i>	1800					1800				
<i>Video Bit Rate (Kbits/sec)</i>	215.95	215.68	216.79	217.64	867.63	206.59	217.22	208.36	207.69	208.36
<i>Frame Rate (fps)</i>	7	6	8	9	9	15	15	15	15	15
<i>Average Frame Size (Bytes)</i>	3877	4371	3543	2941	11724	1729	1728	1727	1724	1727
<i>Variance</i>	309660	246830	175860	126850	10834000	87849	42805	47428	42892	47428