INFORMATION SOCIETIES TECHNOLOGY (IST) PROGRAMME

Contract for:

Shared-cost RTD

Annex 1 - Description of Work

Project acronym: ViSiCAST
Project full title: Virtual Signing: Capture, Animation, Storage and Transmission
Contract no.:
Related to other Contract no.:

Date of preparation of Annex 1: 9 October 1999

Proposal number: IST-1999-10500
Operative commencement date of contract:

Contents

1. Project Summary

1.1 Objectives

ViSiCAST will develop, evaluate and apply realistic virtual humans (avatars) to the generation of European deaf sign languages and develop systems for the storage and transmission of virtual signing. It will refine user-friendly methods for capturing signs (where appropriate) and will create a machine-readable notation to describe sign-language gestures (hand, face and body) which can be used to retrieve stored gestures or to build them from low-level motion components. It will use this descriptive language to produce tools which can translate from both speech and text into signing. By building applications for the signing system in television, multimedia, World-Wide Web and face-to-face transactions, ViSiCAST will enhance the status of Europe's deaf citizens by improving their access to public services and entertainment, and enable them to develop and consume their own multimedia content for communication, leisure and learning. The systems created by ViSiCAST have much wider application to information technologies. Both the gesture description language and the associated real-time virtual humans will be employable in the human-computer-interface of many applications.

1.2 Description of Work

ViSiCAST seeks to improve access to information, entertainment and educational services for people who are pre-lingually deaf and for whom a sign language is their first language. Their difficulties approximate to those of hearing people learning a second language. Many deaf people find it very difficult to acquire verbal skills, especially reading. ViSiCAST will develop enabling technologies to provide signing (in different European languages) from (initially annotated) text, from the captured motions of a skilled human signer, and from speech. These technologies will be utilised in applications for the Internet, broadcasting and face-to-face transactions with the goal of increasing the independence and enhancing the quality of life of deaf people. The project has research and application components: they will interactively develop a number of essential tools. A core enabling technology for all the applications is a text-to-sign language generator and the project will research techniques for providing semi-automatic signing from text. This process will require techniques for moving from English to an intermediate representation and thence to a European sign-language expressed in a flexible computer-readable notation (we intend to extend the HamNoSys system developed at the University of Hamburg to conform to the emerging XML standard). The project will build upon existing work on virtual humans to produce a photo-realistic signing avatar, acquired by 3D scanning of humans, which can be driven in real-time from the motions of a human signer or from animation parameters. The avatar will also be used to provide signing to investigate the provision of communication for deaf people in face-to-face transactions in a post office. A key component of the project will be evaluation. Field-trials of the applications developed will be evaluated by deaf users in conjunction with the RNID and the IvD. Feedback from users will be used to refine the applications.

1.3 Milestones and Expected Results

A key result in year 1 will be a live signing system for TV using a virtual human according to a new standard transmission format, trials of face-to-face communication with deaf subjects and initial Web-based tools. In 'face-to-face communication' the project will not consider a return path (sign recognition to speech synthesiser) the assumption is that answers to questions communicated through the speech-to-sign system will be simple, for example yes or no.

Year 2 will deliver an ambitious prototype text-to-signing tool and an avatar driven from HamNoSys.

Key year 3 results include a face-to-face dialogue system, a semi-automatic translator from text to signing implemented within a Web browser.

2. Project Objectives

The goal of ViSiCAST is to improve the quality of life of Europe's deaf citizens by widening their access to services and facilities enjoyed by the community at large. The chosen medium of communication for the deaf community is the European deaf languages and hence services and facilities must be made accessible through these recognised European languages. The project identifies a number of aspects of life where the integration of deaf individuals in society would be improved if sign language communication was available: access to public services, commercial transactions and entertainment, learning and leisure opportunities including broadcast television and the World-Wide Web.

European legislation (being implemented within the statutes of the Member States) now requires that access to all services is made equally available to all citizens. This will mean that a very large number of companies, offering very diverse services, will have to address the issue of communication with sensory impaired people. At present, such communication relies heavily upon human sign language interpreters, but there can never be enough of these skilled individuals to be present at every face-to-face interaction or even to sign a large proportion of broadcast television.

The objective of the ViSiCAST project is to produce adaptable communication tools allowing sign language communication where only speech and text are available at present. These tools will be based on advanced technology for the synthetic generation, transmission, and storage of sign language to be developed by the project.

By the end of the project:

(i) a face to face transaction virtual signing system will have been trialed in UK Post Offices by at least 2 clerks and a panel of 5 deaf users;
(ii) the signing preparation and virtual signing system will have been used to prepare and present at least 4 sample television programmes with virtual signing, and the feasibility of broadcast transmission of virtual signing within MPEG-2 multiplexes will have been established both through transmissions in the UK and Germany;
(iii) the World-Wide Web tools will have been installed and used in Web sites, and these will have been evaluated by representative members of the deaf community. The aim is to install examples of the annotated GML-based signing on at least 5 of the Web sites of the ViSiCAST participants.

To achieve these objectives the project is structured to have three application-orientated Workpackages, each focusing on the technical issues in delivery for that specific application area, and two enabling technology Workpackages, focusing on virtual signing, sign language representation, and sign language synthesis from conventional textual sources. A further evaluation Workpackage is concerned with eliciting feedback from deaf people at various stages within the development of the system.

3. Participant List

Role	Participant no.	Participant name	Short name	Country	Status	Date enter project	Date exit project
CO	1	Independent Television Commission	ITC	UK	C	start	end
CR	2	Institut für Rundfunktechnik GmbH	IRT	D	P	start	end
CR	3	Televirtual Ltd	TV	UK	P	start	end
CR	4	University of Hamburg (Institute of German Sign Language and Communication of the Deaf)	UH	D	P	start	end
CR	5	University of East Anglia (School of Information Systems)	UEA	UK	P	start	end
CR	6	Institut National des Télécommunications	INT	F	P	start	end
CR	7	Instituut voor Doven	IVD	NL	P	start	end
CR	8	The Post Office	UKPO	UK	P	start	end
CR	9	Royal National Institute for Deaf People	RNID	UK	P	start	end

4. Contribution to Programme / Key Action Objectives

ViSiCAST will comply with the 5th Framework's thematic programmes by improving quality of life and of living resources for deaf people and for the hearing who need to communicate with them. ViSiCAST will also aid the creation of a user-friendly information society: its signing virtual human will be a natural, intuitive human-machine interface. This aspect will be enhanced by its linking, within the project, to speech-to-text systems.

This work is state of the art, building directly on relevant past experience in the field held by individual members of the consortium. It will contribute to the 5th Framework's horizontal programmes by confirming the international stature of European Community research in the field of computational linguistics and real-time virtual human animation. Key companies in the project are SMEs. This is again in-line with 5th Framework horizontal programme objectives.

ViSiCAST contributes to the particular aims of the IST work programme as follows:

Key Action 1: **Services and Systems for the Citizen**

1.1.2.-1.3. Persons with special needs, including the disabled and elderly

ViSiCAST addresses the needs of a section of society which suffers a functional impairment. It will extend access to communications, entertainment, leisure and learning systems to this section of society, in what is for many of them, their language of first choice. It should be understood that the differences between sign language and verbal language are such that people who are born deaf, and who have signing as their first language, rarely achieve full fluency with verbal means of communication. Not only do they have (obvious) problems with speech, but many of them never achieve reading speeds comparable to those of the adult population at large. Because modern communications systems are increasingly text-driven, the deaf community finds itself at an increasing disadvantage. Through the production of digital systems which communicate in sign language, ViSiCAST addresses this problem.

1.1.2.-1.3.1 Systems and Services for Independent Living

ViSiCAST will improve access for members of the deaf community to information and leisure services (broadcast TV and the Internet) and to face-to-face transactions in post offices and other commercial outlets. It will help them to integrate more fully into society and to enjoy services and sources of information taken for granted by most people. The ability to conduct transactions with officials, counter clerks, sales assistants and others through the medium of sign will greatly enhance their independence.

Key Action 3: **Multimedia Content and Tools**

1.1.2.-3.4.1 Multilinguality in digital content and services

The ViSiCAST project draws on a number of human language technologies, including machine translation, speech to text, and facial and gesture animation. In particular, it addresses multi-linguality in digital content and services by creating tools which allow services based predominantly

on verbal language - speech and text - to offer a signed equivalent. Moreover, the system will be developed to translate between English and the sign language equivalents of English, Dutch and German). Thus the signing component of that system should be seen not as a unique service for the deaf, but an extension of services being developed for society at large, to include deaf people.

1.1.2.-3.4.2. Natural Interactivity

The human machine interface at the core of all ViSiCAST objects is based on a natural interactivity, using human languages - signed and verbal. The virtual human will communicate with deaf people in their own first language. The Web activity will create a new form of interactive electronic publishing, while the face-to-face transactional systems will be interactive in direct, real-time communication.

Other aspirations within key action three will also be addressed: the communication flow is multi-sensory, in that it takes in speech (as well as text) and outputs a visual means of communication (1.1.2.-3.5.2.). The Web and broadcast television activities will generate new protocols and standards - some of them capable of incorporation within existing standards such as MPEG-2 and possibly MPEG-4 & 7 (1.1.2.-3.5.2.).

5. Innovation

ViSiCAST will use new multimedia technologies to improve radically the quality of life of deaf people by providing more effective and cheaper ways to communicate. Video, CD-ROMs and videophones are already improving communications for deaf people by providing a medium for recording and transmitting sign language. They do not, however, address all situations - for example in television, cinema or the theatre, or in a face-to-face interaction with a non-signer. In interactive web systems deaf children are also found to have greater problems than those who can read more easily. Despite recent advances in video compression, the bandwidth and storage demands of video still make video an expensive medium. ViSiCAST addresses all these problems by providing low-bandwidth and hence low-cost solutions.

Members of the ViSiCAST consortium (TV/UEA/ITC) have previously developed a system to translate a text stream into simplified forms of sign, such as Sign Supported English. Although many do not regard 'sign supported' communication as true sign languages (because they broadly follow the syntax of verbal communications), such forms of signing are widely used by members of the deaf community. This system assumes a direct, sequential correlation between 'word' and 'gesture'. It stores individual gestures as a file comprising motion data for hand, body and face movements. Run-time software calls these files on the basis of an input text stream and creates a synthetic, virtual human, signing-stream by interpolating in 3D space from one gesture to the next.

A key innovation of the ViSiCAST project will be to develop an automatic system to generate synthetic signing in what may be regarded as the true, or complex, forms of sign language, such as German Sign Language (DGS), Dutch Sign language (NGT), or British Sign Language (BSL).

These sign languages have different lexicons and grammar. Different body parts are used to generate gestures for different signs in parallel; modifiers - such as facial expressions - are used to provide context which may radically change (or even reverse) the meaning of a signed sequence. Position or direction of signing may relate it to somebody present or previously mentioned, or may indicate a temporal variation (past, present or future). Totally different signs may be used to indicate certain objects depending on context. For instance, a book is usually indicated by an iconic gesture, palms together, outstretched, opening to simulate the opening of a book and its pages. But in a sequence describing the giving of a book to somebody else, the gesture for the book may be in the form of the hand shape used for taking a book down from a shelf.

A system to address these complex languages will require many new state of the art features. The ability to construct hand shapes and movements dynamically will be essential. This in turn will require an innovative machine-readable notation to describe gestures (including the various elements of hand, body and face). No such detailed notation currently exists, although the ViSiCAST consortium includes the team which has to date progressed furthest in the field. The option to capture basic static shapes through motion capture technology will be explored, in conjunction with the possibility of acquiring longer, frequently occurring sequences (idioms) as discrete files. This will serve the double objective of ensuring maximum flexibility and maximum realism. This combination of capture and synthetic generation is itself an innovative real-time animation technique

ViSiCAST will also innovate in the field of human motion capture itself. Members of the consortium have developed a hi-resolution system to acquire sign language gestures. This uses

optical capture of facial expression, magnetic body suit capture of body position and posture, and bend-sensor data gloves to acquire detailed information of hand and finger position and orientation. Having researched in this field for three years, participants in the project believe it is clear that no purely optical system to acquire all the elements of sign currently exists or is likely to become available in the immediately foreseeable future. It is the intention of the project, however, to define and create increasingly simplified and user-friendly tools (hardware and software) for the acquisition of signing gestures, and by implication therefore, human movements in general. Such a system is likely to use off-body mounted cameras to acquire facial and body moves, using statistical pre-cognition of 'legal' positions. The intention is to create innovative tools using this technology, coupled with data gloves, to produce a motion capture system capable of use by non-specialist operators. This will allow the easy data-recording of signed performances within a television studio and by members of the deaf community themselves. The run-time signing software will also be further developed to allow the integration of virtual human models acquired from life by the latest 3D scanning techniques.

ViSiCAST will address the text-to-signing problem in a novel way by decomposing it into two stages. First, English text will be translated into an internal representation (envisaged as Discourse Representation Structure) to support resolution of inter- and intra-sentential co-references. From this internal representation, conversion of British, Dutch and German sign languages will be via language-specific lexicons and a generic formulator/planner which models the 3D signing space around the signer during sign formulation.

Another important area that ViSiCAST will address is face-to-face communication for the deaf. Some members of the consortium have already begun experimenting with a system to provide very limited signing to deaf customers in a post office setting. This system will be greatly extended to enable the post office assistant to speak in an unconstrained way to a system that will recognise and 'understand' his/her speech and which will then synthesise an appropriate response in sign-language. The system will go on to use newly developing image- and pattern-processing techniques (that are well advanced in the labs of consortium members) to incorporate recognition of a limited number of signs made by the deaf customer. Although there are now several experimental systems that incorporate speech understanding to provide a service, they are mostly based around remote (telephone) access and upon understanding the speech of the caller alone. The innovative system proposed here will integrate understanding of the post office assistant's speech and the deaf customer's signs, to control the dialogue in an intelligent fashion. The naturally restricted nature of the transactions at a post office helps to make this novel approach potentially successful.

6. Community Added Value and Contribution to EU Policies

Deaf people, who comprise an increasingly active and aware section of European society, are at a disadvantage compared to hearing people not only on account of their disability but as a consequence of their being prevented from engaging in services enjoyed by the community at large. ViSiCAST will improve the quality of life of Europe's deaf citizens by offering them access to many of those services and facilities. It will do this by creating advanced tools for the synthetic generation, storage and transmission of European deaf sign languages.

These tools will improve the integration of deaf individuals in society by allowing them access to widely available communications tools. This will in turn give them increased access to public services, commercial transactions, entertainment, educational and leisure opportunities, including broadcast television and the World-Wide Web.

The ViSiCAST project will operate at European rather than national level because:
It requires access to varied expertise and resources distributed around Europe.

(i) It requires detailed understanding and analysis of a number of European languages, both verbal and signed, which is only really available from individuals and organisations experienced in those languages as native speakers.

(ii) Product from the research element requires subjective and technical evaluation which will benefit from cross national testing to ensure that methodologies have not been adopted which are language or local culture specific.

(iii) It will generate new protocols and standards for the distribution of signed content via broadcast TV and the Internet which will require adoption at International level.

(iv) By addressing the particular requirements of the DVB/MPEG standards régimes, where appropriate, ViSiCAST will strengthen the international position and standing of European Commission-supported research.

There is a relatively high proportion of UK participants within ViSiCAST. This is because the initial first-generation work on virtual signing was carried out as part of the ITC's private out-sourced research programme. ViSiCAST represents the 'export' of this work to the wider European consortium and also brings in additional European expertise.

7. Contribution to Community Social Objectives

With regard to social policy, ViSiCAST will comply with the EU's objectives by improving quality of life and of living resources, for deaf people and for the hearing with whom they need to communicate. ViSiCAST will also aid the creation of a user friendly information society: its signing virtual human will be a natural, intuitive human-machine interface. This aspect will be enhanced by linking it, within the project, to speech to text systems. These measures will help a larger section of society to use and interact with computer-based information systems.

ViSiCAST contributes to the social objectives of the Community as enshrined in Key Action 1 of the IST work programme as was described in Section 4.

ViSiCAST participants are aware of serious ethical dimensions pertaining to their work.

Deaf communities around Europe have a shared history of repression and neglect. Historically, many deaf people were treated as mentally deficient. In some countries, the use of sign language was actively repressed. It is only relatively recently that deaf communities came to be appreciated as blessed with a culture and value system of their own. Deaf people regard sign language as the natural expression of this culture. While many are keen to enjoy the rapidly developing benefits of the digital age, they do not want to do so at their expense of their identity. It is important that synthetic signing systems as envisaged by ViSiCAST are developed to be used, and to be of use, to deaf people. They will need to be able to use the new systems to both generate and consume signed product - otherwise it will become nothing more than a mechanism for dictating to deaf people.

ViSiCAST will ensure adherence to these principles by involving and empowering deaf people at both the stages of evaluating and testing of systems, and - equally important - in the defining of legitimate goals. The University of Hamburg (which will be working on the development of sign language notation and translation) is a teaching institution with the active involvement of deaf individuals. The IvD, in The Netherlands (which will be working on the development of multi-media learning tools) is closely involved with its own deaf community. The Royal National Institute for Deaf people (RNID) in the UK is run by deaf and hearing people working together. It provides services for the deaf community and manages teams of sign language interpreters.

8. Economic Development and Scientific and Technological Prospects

It is only in recent years that the technology required to produce 3D virtual humans which are capable of intelligible and smooth deaf signing, has been possible. Experience has already shown the ViSiCAST participants that if the virtual human is to be acceptable to deaf people as a means of communication, it must have a high degree of verisimilitude. Furthermore, technology to do this no longer requires super computers for real-time operation but can be handled on the humble PC. Of course, the production and interpretation of sign languages requires far more than merely the virtual human; linguistic representation, summarising and interpretation all require computer processing. These functions, however, can be separated as part of the media production or editing task or, in the case of constrained speech recognition, can also be handled in the PC. Thus for the application areas of ViSiCAST, the economic as well as technical landscape is right for product prototype development within the 3-year span of the project.

The size of the market for products employing deaf signing is not large, amounting to less than 0.1% of the population, however, the number of services which will be required by European disability discrimination laws to be available to pre-lingually deaf people is large, making commercial prospects more optimistic than they might at first appear.

In the UK, legislation under the 1996 Broadcasting Act has required broadcasters of digital terrestrial television services to begin providing signing for 1% of their output in 2000. This must increase to 5% over the first 10 years of the services. A simple look at the economics reveals that (given that there are about 20 digital terrestrial channels excluding BBC services for which the legislation does not apply), the costs of signing using real humans and the associated studio equipment runs into many millions of Euros and will increase year upon year. It is worth pointing out, too that the same companies are required to produce audio description for blind people (for up to 10% of programmes over 10 years) and to increase subtitling from the present 50% to 80%.

Money is not the only scarce resource influencing the provision of signing on television. The number of highly qualified signing interpreters is small and the capacity of the digital terrestrial transmission multiplex would be strained by having to carry conventional MPEG-2-encoded pictures of real humans signing.

If virtual human signing can eventually operate from the sub-titled text, not only would many of the resource problems be solved, by the deaf community could have access to between 50 and 80% of programmes through signing. Solving all the linguistic problems necessary to produce British Sign Language automatically is beyond the term of the project, but substantial progress in this direction will be made. The transmission system will be developed and proven, as will the virtual human, which will be capable of running in the processor of any set-top box or domestic PC.

Although at its start, signing in the UK will have to employ MPEG-2-based transmission, because the technology is more readily understood at this time, no working prototypes of this approach have yet been demonstrated. There remains great interest in the potential of ViSiCAST's work, and as yet there is no legislation for UK satellite services, or closed signing of any kind in other countries world-wide which have adopted the standards set by DVB.

Web and multimedia access for those who are not fluent in text-based languages is a major untapped area of product development which ViSiCAST is aiming to address. The Web is increasingly becoming a communication medium as well as an information medium, and ensuring that everyone has access to it for education and trading, makes powerful commercial sense. The strategy of ViSiCAST is to give away a version of the browser to seed as large a market of users as possible, and then to charge companies for the authoring tools which will allow them to be able to present their Web sites as accessible to deaf people.

Similarly, the potential number of face-to-face transactions involving deaf and hearing people is enormous, involving every shop, bank, agency, cafe or social service. The opportunities to sell products into their market are obviously significant.

Of course, there will be spin-off applications, which the participants in ViSiCAST are well-positioned to exploit, either directly or through licensing of the required IPRs. One such area is the virtual human itself. How long will it be before we are addressed by a real-looking virtual human at ever hole-in-the-wall money access centre, for example? Or when we attempt to programme the VCR or call an number on a mobile phone? He or she, might sign for the benefit of pre-lingually deaf people but might equally speak Spanish or Punjabi for those who wish to be addressed this way. ViSiCAST's virtual human will have much more detailed and natural hand or face gestures than any other available, and this alone will enhance their para-social interaction with user. Having the friendliest virtual human at your bank or in your product could give you a commercial advantage in many products.

In the entertainment industry, motion-capture is a correspondingly important technology. Currently it figures highly in computer games, but as the capture becomes more sophisticated it will contribute to the task of recognising gestures, which will further improve person-to-person and person-to-machine interactions for the population as a whole.

General advances in computer linguistics will also emerge from the project, advancing the way that language interpreting and summarising operate. This may well make it easier for work beyond the term of the project to convert from text or speech to other sign languages such as American Sign Language.

9. Work Plan

9.1 General description

Introduction

The ViSiCAST project addresses the needs of the deaf community across Europe. The project aims to improve two-way communication between the deaf and the speaking community, and to allow the deaf community to continue to develop its own unique culture. Poor access to television excludes deaf people from the major source of news and information, entertainment, education, and (modern) culture available to the speaking world. With the convergence of digital broadcasting and broadband multimedia on the Internet, it is increasingly important that the needs of deaf people are addressed through signing, as recognised by legislation in the UK. The emerging MPEG-7 standard makes provision for simultaneous captioning through description schemes using XML.

To address these needs, ViSiCAST will employ the technological expertise of the participants to support translation between written or spoken languages and signing. Automatic assistance with translation of text, and where appropriate spoken language, into sign language will give access to a wide range of materials currently inaccessible to the deaf. In addition to broadcast captioning, systems for recognising a limited range of signs will allow deaf people to participate with greater ease in many transactions in social contexts such as post offices, health centres and hospitals, advice services, and shops. A simple system by which the deaf can add signing commentary to text and pictures will enrich interaction between the deaf using the World-Wide Web.

Most of the technical deliverables from ViSiCAST involve the animation of signs from gestures using an avatar. Existing systems which translate text to sign (such as that previously developed by ViSiCAST participants) are based on ‘stitching’ together motion sequences corresponding to a series of signs, in turn corresponding to spoken words. The second generation system produced by ViSiCAST aims to handle full signing languages from a number of European countries, rather than the sign supported languages addressed by first generation systems. It will also handle other idiomatic gestures. The avatar technology will form the basis for presentation of signing by television, in kiosks and at counters in social environments, and third-party software and through web browser plug-ins for Internet access to signing.

Since the deaf community constitutes a relatively small economic sector, defining and using pan-European and international standards for communication through sign language will enable the largest number of deaf people to benefit from the outcome of the ViSiCAST project. It is essential that organisations for the deaf are closely involved in the project, ensuring a clear focus on the key needs of the community, and promoting the outcome of the project to the widest audience.

The means to achieve the ViSiCAST objectives are provided by a series of eight Workpackages. The first three directly address applications of virtual humans to signing: to television, to multimedia and the Web, and to face-to-face service transactions. These are, in turn, dependent on technology and research carried out in Workpackages 4 and 5 respectively. The remaining Workpackages are designed to monitor, manage and disseminate results from ViSiCAST.

ViSiCAST envisages three main application areas for its technology:

(i) The project will progress broadcast system specifications and standards for the transmission of 'closed' signing through participants from national broadcast regulatory authorities and participants participating in the DVB consortium and the activities of the Moving Picture Experts' Groups (MPEG). Associated with these developments will be experiments with various approaches to presenting photo-realistic signing, building on participants' existing first generation technology which delivers realistic signing motion using 3D animated virtual humans. The aim will be to deliver effective signing through relatively low capacity channels using encodings that capture the semantics of the signed language [1,2].

(ii) To enhance the opportunities for deaf people to interact with the speaking community, leading experts in speech recognition within the project will develop speech-to-sign systems coupled with limited gesture recognition to provide two-way communication. This is technically ambitious, but will be made tractable by focussing on situations where the range of dialogue is naturally constrained, such as transactions in a post office. The UK's national Post Office is a member of the project.

(iii) Tools will be placed under the control of the deaf community by the project providing text-to-signing applications and plug-ins for use in education and personal communication on the Web and broadband multimedia. Tools will provide semi-automatic translation and allow editing to create true signing.

Enabling Technologies

Development of the application areas relies on research to enhance underlying technologies in the area of language translation, animation, and gesture recognition.

- Existing technology will form the basis of text translation to Discourse Representation Structures (DRS) [3] to identify the object references that are crucial to true sign language translation. Speech recognition systems will provide source text in some applications. Previous work by participants has translated English text to Sign Supported English [4,5], which provides a first step and delivers benefits in educational contexts, but by no means addresses all the concerns of the deaf community. DRS, principally from English text, will be analysed to generate signs in several European sign languages such as British Sign Language, German Sign Language, and Dutch Sign Language. This will be a major task for the project and considerable manual intervention will be needed in early deliverables.

- Representation of the sign languages will be based on the universal notation system, HamNoSys [6], developed by one of the participants. This notation has been developed for the study and analysis of signs, and will now be adapted by ViSiCAST to form a notation for driving a signing avatar. A novel and innovative computer-readable version of the notation, ViSiCAST Gesture or Sign Mark-up Language (GML) will be developed. ViSiCAST-GML will conform to the XML standards, and will be integrated with the work on broadcast standards within the applications Workpackages.

- The first generation avatar system developed by participants will be enhanced to respond to ViSiCAST-GML, to provide signing that is as effective as systems based on direct transmission of motion parameters. Adaptations to provide photo-realism are needed to improve the subjective quality of the signing and enhance 'legibility' for the consumer.

- For two-way communication and for real-time broadcast experiments it will be necessary to capture gesture information from signers. For early experiments, a hybrid approach will be pursued, using analysis of video images to identify gross body movements and lip movements, but employing sensitive data gloves to capture fine hand movements which are central to signing. (Experiments with analysis of video images of hand movements will also be performed to explore the possibility of systems based on purely video information, but the success or failure of the project as a whole will not depend on the success of these experiments).

Supporting Activities

ViSiCAST participants realise that the value of their work depends on the extent to which it addresses the real needs of the deaf community. The partnership includes members from national deaf organisations, deaf schools, and leading academic deaf studies departments.

- A deaf organisation will lead a strand of evaluation of early project deliverables, allowing feedback to focus the project in its later stages. Deaf signers and translators will be essential members of the ViSiCAST team.

- It will also be important to promote the project carefully within the deaf community, so that expectations are realistic and so that tools are matched to appropriate application areas. Promotion of broadcast specifications and standards developed by the project will be an important part of ensuring the lasting impact of the project and eventual exploitation of its product.

- Effective and strong management of the project is essential and the co-ordinating participant has a successful record of leading national and European collaborative projects.

Methodology

The starting point for the project is a working prototype automatic signing system [4,5,8]. As has been indicated above, to structure development from this point, the participants have identified three main application areas and two areas requiring new basic research. The applications (which are closely inter-related to the project's ultimate exploitation aims) are in TV, in the signing of stored text and in face-to-face transactions [7]. Work on the applications will start immediately using the existing signing system. The application systems will be refined on the basis of feedback from the evaluation process, which has been assigned its own Workpackage to reflect the crucial dependence of the project on the involvement of the deaf community.

The underlying methodology is that results from the research Workpackages are input to Workpackages that address applications, which are then evaluated. Results from evaluations may be used to both revise the research objectives and to refine the applications. In general, the project methodology is to break a task into sub-tasks and to conceptualise each of these in the simplest possible terms. The experience and knowledge gained from this process is then used as the basis for research into a task that more accurately reflects the real-world situation.

The Work plan is arranged so that some effective Deliverables are available relatively early. These will be based on a large degree of manual intervention in the process of translating to sign language, or on the use of unmediated signing recorded as discrete performances. Some may be based on sign

supported languages as an interim stage towards full sign languages. Feedback from the deaf community will refine the objectives for later stages, when improvements in language translation technology will allow high-quality signing with less manual intervention.

Teams working on a group of related Workpackages will be able to progress between milestones/ deliverables with relatively little dependence on other groups, so that changes in the pace of progress within the project will not have serious repercussions.

Summary of Workpackages

Workpackage 1: Television & Broadcast Transmission

Workpackage One is concerned with the deployment of virtual human synthetic signing in broadcast television. The Workpackage thus has two related aspects: the development and integration of the appropriate technology, and the monitoring and establishment of appropriate standards.

Workpackage 2: Multimedia and WWW Applications

This Workpackage will develop applications of virtual signing aimed at the WWW, multimedia and third party software. An Internet browser plug-in will be developed, which will allow the viewing of text as signs. A version will be provided free of charge to deaf users.

Workpackage 3: Face-to-Face Transactions

This work package will develop applications of the virtual human signing system to be used in face-to-face transactions, such as post offices, health centres and hospitals, advice services, and shops.
The scenario for these transactions will be a post-office. The system to be developed will allow the counter clerk serving the deaf customer to speak into a microphone and have his or her speech translated into on-screen virtual human signing. To improve the efficiency of the transactional system, it will incorporate available technologies to "read" limited signs from the deaf customer and translate these into text (or speech) that the counter clerk can understand.

Workpackage 4: Animation & Modelling

This is the first of the technology work packages underlying the planned applications described above. Individual components of shape and movement may be acquired from life (motion capture) or constructed in 3D graphic space using physical modelling tools. Tools based on each system will be developed in parallel, evaluated, and deployed as appropriate. For use with the direct recording of signed sequences, the project will develop a refined suite of advanced Motion Capture Tools, forming a single, coherent, capture, recording and replay system, using robust techniques and equipment capable of use in TV studios and other industrial, non-laboratory settings.

Workpackage 5: Language and Notation

This is the second of the underlying technology packages. This package will move from the presentation of manually encoded versions of sign language (such as Sign Supported English) generated from text – as in the 'Simon-the-Signer' prototype system previously developed by ViSiCAST participants – to the much more complex problem of describing, encoding, and presenting natural European sign languages, derived from English textual sources. The enabling technology here is a sign language notation already under development by the University of Hamburg, HamNoSys, which will be further developed to give an XML-compatible notation, ViSiCAST-GML. The required lexicons will be developed using this notation.

Workpackage 6: Trials and Evaluation

Informal feedback and evaluation is an inherent aspect of the entire project methodology. Furthermore, more formal evaluation of the work – by deaf users – is seen as of such importance that it has been given its own work package. Throughout the project, members of the deaf community in several countries will evaluate the quality of ViSiCAST virtual humans, and the signing they generate.

Workpackage 7: Project Management, External Communications and Publicity

This Workpackage is concerned with the overall management of the project including external communications. The aims of the project management are to monitor and co-ordinate the activities of participants to ensure that that the work plan is followed, that any adjustments are made in a properly controlled manner, and that the project is thus effective in producing output which will meet the needs of EU deaf citizens.

Workpackage 8: Exploitation and Dissemination

This Workpackage is intended to ensure that the outputs of the project are disseminated and exploited as effectively as possible. In conformity with the co-ordinator's guidelines, a detailed dissemination and exploitation plan will be developed in the first six months of the project (as the first deliverable of this WP) and submitted for approval by the Project Officer.

References

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[3] van Eijck, J and Kamp, H, 1997, 'Representing Discourse in Context', in *Handbook of Logic & Language*, van Benthem, J & Ter Meulen, A, eds, Elsevier, 1997.

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[6] Prillwitz, S, *et al*, 1989, 'HamNoSys Version 2.0, Hamburg Notation System for Sign Languages - An Introductory Guide', 1989 (International Studies on Sign Language and Communication of the Deaf; 5) Hamburg : Signum 1989 - 46 p.

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9.2 Workpackage List

B1.	Workpackage list

Work-package no.[1]	Workpackage title	Lead contractor	Person-months[2]	Start month[3]	End month[4]	Phase [5]	Deliv-erable No[6]
1	Television & Broadcast Transmission	ITC	50	1	36		1-1 to 1-3
2	Multimedia and WWW Applications	IvD	79 (+15)	1	36		2-1 to 2-3
3	Face-to-Face Transactions	UKPO	56 (+14)	1	36		3-1 to 3-3
4	Animation & Modelling	TV	115 (+4)	1	36		4-1 to 4-4
5	Language & Notation	UH	118 (+29)	1	36		5-1 to 5-4
6	Evaluation	RNID	34 (+4)	1	36		6-1 to 6-3
7	Project Management	ITC	20 (+6)	1	36		
8	Exploitation and Dissemination	ITC	18 (+1)	1	36		
	TOTAL		490 (+73)				

[1] Workpackage number: WP 1 – WP 8.
[2] The total number of person-months allocated to each Workpackage (figures in parentheses refer to effort provided by 'Additional Cost' participants from their own resources).
[3] Relative start date for the work in the specific Workpackages, month 0 marking the start of the project, and all other start dates being relative to this start date.
[4] Relative end date, month 0 marking the start of the project, and all end dates being relative to this start date.
[5] Used only by combined research and demonstration projects: R indicates 'research' and D indciates 'demonstration'.
[6] Deliverable number: Number for the deliverable(s)/result(s) mentioned in the Workpackage: D1 – D8.

9.3 Workpackage Descriptions

Note: In the following Workpackage descriptions additional participant code designations are introduced for the administrative convenience of the project. Both 'ITC-U' and 'UKPO-U' mean 'UEA', and 'ITC-T' means 'TV'.

B3.	**Workpackage description**			
Workpackage number :	**1**	Television & Broadcast Transmission		
Start date or starting event:	Month 1			
Participant number:	2	5	6	6
	IRT	UEA	INT	ITC-T
Person-months per participant:	21	7	16	6

Objectives

1 Development of technology for low bit-rate signing transmission in broadcast TV. This will use signing captured directly from an expert signer, and will produce a television broadcast system for delivering sign language from this source to a photo-real virtual human driven at the receiver. The broadcast will either be of a live signer or of a recorded signer.

2 Further development of technology to transmit signing represented in the ViSiCAST-GML intermediate language (defined in Workpackage 5).

2 Ensure that ViSiCAST technology is properly integrated into relevant international standards. On the one hand, ViSiCAST technology should exploit existing standards, wherever relevant. On the other hand, the innovative aspects of ViSiCAST technology should be incorporated into emerging standards and systems, such as the multimedia home platform (MHP) within DVB, and the MPEG series of standards.

4 Develop strategies for the implementation of the virtual signer in television set-top boxes, through consultation with the consumer electronics industry.

Description of work

Proposal of appropriate XML-extension for standardisation to the Multimedia Home Platform (MHP) project within the DVB standard.

Suitability research on existing broadcast transport layers, such as Intercast/ATVEF, DAB or DVB for ViSiCAST data transmission.

Definition and development of software converter tools for sign-language into broadcast format (VBI, MPEG-2 and/or MPEG-4 and/or MPEG-7).

Requirements definition for, and development of hardware insertion tools ("multiplexer") on transmitter side via VBI or appropriate MPEG standard.

Virtual human body animation, within MPEG-4 framework, including:

i. translation of captor's parameter set into MPEG-4 Body Animation Parameters (BAPs);
ii. modelling and animation of ViSiCAST-VH (analogous to VRML H-anim) virtual humanoid in MPEG-4 context;
iii. encoding of BAPs.

Development of appropriate sign language Description Schemes (DSs) for ViSiCAST-GML within the framework of the emerging MPEG-7 standard for a general purpose 'Multimedia Content Description Interface', investigating also different approaches allowing the derivation of the corresponding descriptors from monoscopic video sequences.

Deliverables

1-1 *Direct-sign* 12
Demonstrator of system for low-bandwidth transmission of signing to accompany broadcast TV, based on captured motion parameters driving a virtual human at the receiver. An extract of pre-recorded television together with an associated ViSiCAST data-file will be transmitted and successfully reconstructed in a PC-based receiver.

1-2 *GML-sign* 33
Prototype implementation of broadcast TV system for low-bandwidth transmission of broadcast TV with signing represented in ViSiCAST-GML.

1-3 *TV-Specifications* 30
Report on specifications and standards activity, covering *inter alia*:
i. relation of ViSiCAST transmission technology with MPEG-2 transport layer standards;
ii. integration of ViSiCAST motion parameters into MPEG-4; and
iii. integration of ViSiCAST-GML signing notation and into the Description Schema (DS) framework of the proposed MPEG-7 standard

Milestones and expected results

1 *TV Specifications-1* 12
Report on broadcast system transport layer standards and service requirements for direct signing from a motion capture system.

2 *TV Specifications-2* 21
Reports to relevant international committees on the compatibility, or otherwise, between a fully functional signing-fidelity virtual human used for direct signing from a motion capture system and the associated standard.

B3. Workpackage description

Workpackage number :	**2**	Multimedia and WWW Applications				
Start date or starting event:	Month 1					
Participant number:	1	3	4	5	7	9
	ITC-U	Televirtual	UH	UEA	IvD	RNID
Person-months per participant:	10(+3)	10	13 (+3)	16 (+5)	22(+4)	8

Objectives

This work package aims to produce tools that will allow a deaf citizen to access multimedia resources though sign language.

Existing multimedia resources are not adapted to support signing so tools must work from text or provide a simple mechanism for adding closed captioning for sign language.

The package relies on the virtual human signer (WP4) which is driven by ViSiCAST Gesture Mark-up Language (GML) (WP5). For partially or fully automatic translation of text into European sign languages, it will rely on translation and editing tools (WP5).

The Workpackage aims to provide access to existing resources by developing an Internet browser plug-in (D2-1), which will allow the viewing of text as signs. It will provide unsophisticated translation into simplified, sign-supported languages. The browser will also provide high-quality signing for pages annotated with GML. A simple version will be made available for free downloading for individual use. The user will be able to control certain parameters of the signer, such as speed, pose, flamboyance and will have a choice of avatars ranging from photo-real to cartoon characters.

Another Workpackage (WP5) will support captioning with high-quality signing using GML by providing authoring tools for creation of new and varied signs and the editing or changing of the virtual human model (D5-4). This technology will enable deaf people to create their own WWW sites in sign language.

Signing support is desirable in other computer software. Versions of (D2-1) could also be produced as plug-ins to third party software. For instance, in the form of a signing lexicon to accompany word-processing packages.

To show that the signing tools produce benefits, it will be necessary to investigate the impact of adding signing to multimedia resources. The browser technology will be used within the project to develop interactive learning materials utilising sign language.

To demonstrate the value of the multimedia tools by enhancing some existing multimedia content for the deaf by the use of signing (D2-3).

An educational package will be produced to help in the learning of sign language and the training of signing translators (D2-3). This package will be available through the World-Wide Web.

Description of work

A tool will be constructed using the first generation avatar, which will take GML (D5-2), using a standard XML parser, and animate a limited number of predefined GML sequences corresponding to symbols in Sign Supported English handled by the existing avatar. The tool will facilitate research into the culture, language development, and education of those using signs for communication. It will provide a vehicle for assessing the capabilities of HamNoSys, the universal sign notation system behind GML.

A prototype version will be produced early in the project (M2-1). The tool will be enhanced as developments are made to both GML and the avatar and will form the basis of the browser plug-in.

The avatar will be enhanced to respond to HamNoSys encoded in GML and hence will be able to sign symbols from any sign language. GML will be enhanced to incorporate additional gestures and idiomatic expressions which will be transferred to the avatar as motion parameters

The browser plug-in (D2-1) will be developed from the GML signing tool and will be tuned for the Web environment. It will incorporate simple text to GML translation (WP5) enabling the signing of arbitrary text with limited accuracy based on sign supported languages. As advanced text translation becomes available, this will be incorporated in a professional version of the plug-in.

A separate package will be produced for semi-automatic translation of text to signs. This will combine translation from text to sign languages (WP5) with facilities for editing the resulting sequences to produce high quality GML sequences for animation by the plug-in (M2-2). Demonstrations of this will be available on at least 5 Web sites of ViSiCAST participants.

A number of existing web sites specifically designed for deaf people will be analysed to determine the vocabulary and range of material that might benefit from signing.

Interactive multimedia educational material developed by IvD, a ViSiCAST participant, will be enhanced with signs using the plug-in driven by specially prepared GML (D2-2).

Materials will be prepared around the sign lexicon developed for (WP5). A multimedia database of signs will be produced using the plug-in to animate GML sequences for individual signs and typical phrases. An educational package will be produced to help in the learning of sign language and the training of signing translators (D2-3). This will be available via the World-Wide Web.

Deliverables

D2-1	*Browser-plug-in*	12
D2-2	*Web-page-sign*	30
D2-3	*Signing-tutor*	30

Milestones and expected results

M2-1	*GML-Tool-Initial*	*9*
M2-2	*GML-edit-tool*	33

B3. Workpackage description

Workpackage number :	**3**	Face-to-Face Transactions	
Start date or starting event:	Month 1		
Participant number:	5	8	3
	UEA	UKPO-U	TV
Person-months per participant:	31 (+4)	21 (+10)	4

Objectives

This work package will develop applications of the virtual human signing system to be used in face-to-face transactions, such as post offices, health centres and hospitals, advice services, and shops. The system will be developed for use in a post office scenario, but it is expected that other applications will be researched independently during the course of the project using the knowledge and experience gained during the project. In the post office scenario, the counter clerk serving the deaf customer will speak into a microphone and his or her speech will be translated into on-screen virtual human signing using technologies provided through work package 4. The first two systems will allow only speech from the clerk to be translated into signing. The final system will provide limited sign recognition to enable a dialogue between clerk and customer.

Description of work

The first deliverable of this system will translate only a constrained set of spoken phrases from the clerk, which may contain a number of variable quantities, such as prices, weights, countries etc. This system will recognise 100 different phrases spoken by the clerk and give him/her the potential to accomplish 80% of all transactions that take place in a typical UK post office using automatic signing. The system will be evaluated by 2 counter clerks, and a panel of 5 deaf users from the RNID, who will be asked to accomplish a number of transactions using the system.

The second deliverable will be a system which extends the initial system to accept much less constrained speech from the clerk: for instance, instead of being required to say “Do you want first or second class postage?” the system would accept “First or second?”. The system will be able to “understand” 95% of phrases spoken by the clerk that have a translation into a phrase contained in the signing lexicon. In addition, the number of transactions that can be performed will be increased to 90% of the transactions that take place in a UK post office by adding extra signs to the signing lexicon. Again, the system will be evaluated by 2 counter clerks and a panel of 5 deaf users from the RNID, who will be asked to accomplish a number of transactions using the system.

The third deliverable will be a system that incorporates a limited dialogue between the clerk and the deaf customer. This system will incorporate available technologies to recognise a limited number of signs from the deaf customer and translate these back into text (or speech) the counter clerk can understand. The intention here is not to attempt a comprehensive translation system for the whole of sign language into text, but rather to recognise a very limited number of signs to develop an appreciation of how sophisticated such a system needs to become before it can begin to be of practical use for members of both hearing and deaf communities. The sign recognition system will achieve an accuracy of 90% on a vocabulary of ten signs recorded by ten members of the deaf

community recruited through the RNID. The complete system will be evaluated by 2 counter clerks and a panel of 5 deaf users from the RNID, who will be asked to accomplish a number of transactions.

Deliverables

3-1	*Constrained PO sys*	7
3-2	*Unconstrained PO sys*	19
3-3	*Dialogue PO sys*	34

Milestones and expected results

Milestones related to Deliverable 1:
Month 2: Recordings of transactions from post offices; real-time speech recognition system
Month 4: Lexicon of avatar signs available
Month 6: Evaluation of system
Month 7: Report

Milestones related to Deliverable 2:
Month 10: Review of current translation systems and decision on approach to translate unconstrained speech into one of a number of transactions
Month 15: Initial system using unconstrained speech to text translation
Month 17: Extended sign lexicon incorporated
Month 19: System evaluation
Month 19: Report

Milestones related to Deliverable 3:
Month 21: Review of current technology for sign recognition and decision on approach to sign recognition
Month 27: Initial results on sign database
Month 30: Enhanced recognition results, incorporation of dialogue system
Month 20: System evaluation
Month 22: Report

B3. Workpackage description

Workpackage number :	**4**	Animation & Modelling		
Start date or starting event:	Month 1			
Participant number:	TV	UEA	INT	ITC-T
Person-months per participant:	19	30 (+4)	38	28

Objectives

This is the first of the Workpackages generating the technological advances underlying the applications addressed in Workpackages 1-3.

It will develop visualisation tools for photo-realistic, real-time animated signing. This will require state of the art modelling and animation tools, both soft- and hardware.

Description of work

The tools will be able to integrate scanned-from-life human models for the virtual signer. Run-time software will be able to dynamically combine individual elements of signing gesture: individual hand and body movements, facial expression etc. to create the complex, non-sequential elements of the true European sign languages. The individual components of shape and movement may be acquired from life (motion capture) or constructed in 3D graphic space using physical modelling tools. Tools based on each system will be developed in parallel and compared for functionality and subjective realism (c.f. Evaluation WP). It is likely that a final system will combine relevant facets from both techniques.

These systems will be capable of being driven directly, using real-time motion capture, from the performance of a human signer or interface to the ViSiCAST Gesture Mark-up Language, written in XML and based on extensive further refinement of a gesture notation scheme being perfected in WP5, Language.

For use with the direct recording of signed sequences, the project will develop a refined suite of advanced hardware and software motion capture tools. These will form a single, coherent capture, recording and replay system, using robust techniques and equipment capable of use in TV studios and other industrial, non-laboratory settings. This system will be available for display, testing and practical evaluation. Similar systems will be developed as appropriate, for physical modelling of shape and motion.

Deliverables

4.1	*Prototype animation system for direct (unmediated) TX*	*9*
4.2	*Notation-avatar software driver*	*24*
4.3	*Final Avatar 3D model(s)*	*29*
4.4	*Advanced MPEG4 animation system*	*30*

Milestones and expected results

B3. Workpackage description

Workpackage number :	**5**	Language and Notation				
Start date or starting event:	Month 1					
Participant number:	1	4	5	6	7	9
	ITC-U	UH	UEA	INT	IvD	RNID
Person-months per participant:	20 (+16)	57 (+8)	9 (+2)	4	15 (+3)	13

Objectives

1. To define the computational and communication interfaces between the various system components. This defines the main interfaces between participants' co-operative work on major system components of the core English to signing translation system.
   These are reported in deliverable 5-1 *Interface Definitions*.

2. To define a ViSiCAST Gesture Mark-up Language (GML) which will be an XML-compliant representation of gestures used to link linguistic analysis work with animation technology.
   These are reported in deliverable 5-2 *GML-def* and continuation of this work will integrate with proposals for Description Schemes in the MPEG 7 standard. The XML definition will be proposed for adoption through W3C, the World-Wide Web consortium (milestone *Final-GML-def*) and will be reported in deliverable 6-3 *Evaluation Report 3*.

3. To implement a provisional text (English)-to-sign notation translator
   The result of this activity will demonstrate:

(i) that the sign lexicon and sign formation rules permit synthesis of readable signs for the 500-sign lexicon concept.

(ii) that standard English construction of active, passive, interrogative and imperative sentences involving relative clauses and adjectives are converted to appropriate semantic representations.
These will be demonstrated in deliverable 5-3 *Proto-text-to-semantic,* evaluated in milestone *Eval Proto text-to-sign* and reported in deliverable *Evaluation Report 1 and 2*. Informal testing will involve approximately 4 deaf people at frequent stages during development. Formal evaluation will involve at least 12 deaf people for each native sign language at the milestone *Eval Proto text-to-sign* milestone.

4. To design and implement a prototype semi-automatic text to sign preparation system, combining *natural language processing* components*, conversion to Sign language notation* representation of sign languages*, modelling of and planning within the 3D signing space* surrounding the signer, and *previewing* of the synthesised signing in any of the three sign languages.

The result of this activity will demonstrate

(i) that the sign lexicon and sign formation rules permit synthesis of readable signs for the 1000-sign concept.

(ii) that the formulator can appropriately handle co-reference as pointing within the 3D signing space.

(iii) that pronominal and co-reference can be handled appropriately within the editing

environment to appropriately facilitate the formulator.

(iv) that aspects of the English tense system, temporal and locative complement phrases can be appropriately handled with the editing environment and converted to the appropriate semantic form.

These will be demonstrated in deliverable 5-4 *Integrated-Edit-env*, evaluated in milestone *Eval-Integrated-Edit-env* and reported in deliverable *Evaluation Report 3*. Formal evaluation will involve 12/15 deaf people for each native sign language at the milestone *Eval-Integrated-Edit-env* milestone.

Description of work

1. The computational and communication interfaces between the various system components

(i) refine the HamNoSys [1] notation for sign language so that it can control a human avatar.

(ii) extend the HamNoSys notation so that it expresses aspects of posture, facial expression.

(iii) define a semantic representation, based on Discourse Representation Structures (DRSs) [2], as the interface between English text processing and the sign language synthesis of the formulator.

(iv) define a common lexicon structure based upon the refined HamNoSys notation (as the basis for 3 lexicons - one for each sign language)

(v) define a DGS grammar for rules of sign formation from the morphological components retrieved from the sign lexicon.

2. The Sign Language notation used in this project, HamNoSys, is an existing internationally recognised notation system for signs. A first version of GML will be defined early in the project as an encoding of Sign language notation using XML. Facilities will allow naming of commonly used signing sequences through a macro or subroutine feature.

In GML, a route will also be provided for transmitting uninterpreted motion information for non-standard idiomatic gestures.

3. Implementation of the provisional text (English) to sign notation involves

(i) development of HamNoSys lexicon entries for initially 500 concept entries for each of DGS, NGT and BSL (to cover a minimal domain). These entries will cover frozen forms as well as verbs incorporating subject and object. This will require sign language expertise for each language.

(ii) definition of a DGS grammar for rules of sign formation from the morphological components retrieved from the sign lexicon and application of this to define comparable formation rules for BSL and NGT.

(iii) implementation of an English to DRS translation system for a representative set of English constructions.

4. Implement a semi-automatic text to sign preparation system,

(i) extending the HamNoSys lexicons to cover a testable domain of about 1000 concepts. (including classifier verbs.)

(ii) development of a user interface for a semi-automatic English to Sign Language Notation translation tool supporting manual intervention and previewing of signed sequences.

(iii) implement an SL formulator/planner to model the signing space (to support the introduction of new discourse referents and anaphora-like references to these).

(iv) extension of the English to DRS translation system to handle the tense system and temporal and locative complement phrases.

[1] Prillwitz, Siegmund*, et al*: 1989, 'HamNoSys. Version 2.0; Hamburg Notation System for Sign Languages - An introductory guide' (International Studies on Sign Language and Communication of the Deaf; 5) Hamburg : Signum 1989 - 46 p.

[2] van Eijck, J & Kamp, H, 1997, 'Representing Discourse In Context', *in Handbook of Logic & Language*, van Benthem, J & Ter Meulen, A, eds, Elsevier, 1997.

Deliverables

5-1	*Interface Definitions*	12
5-2	*GML-def*	15
5-3	*Proto-text-to-sign notation*	18
5-4	*Integrated-Edit-env*	32

Milestones and expected results

Semantic rep def	*3*	Agreed DRS interface format
Lexicon-1	*5*	Agreed Lexicon format
HamNoSys def	*6*	Initial HamNoSys refinements documented
HamNoSys extend	*12*	Facial and body HamNoSys notation documented
Basic-grammars	*18*	Basic grammar for rules of sign formation finalised
Lexicon-2	*18*	Initial 500 concept lexicon finished
Lexicon-3	*29*	Final 1000 concept lexicon finished
Final GML def	*30*	The XML definition will be proposed for adoption through W3C
Extended-grammars	*30*	Grammar for rules of sign formation finalised documentation

B3. Workpackage description

Workpackage number :	**6**	Trials and Evaluation							
Start date or starting event:	Month 1								
Participant number:	1	3	4	5	6	7	8	8	9
	ITC-T	TV	UH	UEA	INT	IvD	PO	PO-U	RNID
Person-months/participant:	1	1	1	3	1	8(+2)	1	3(+2)	15

Objectives

Qualitative and quantitative evaluation of transport mechanisms for and the underlying technology of virtual signing.

Qualitative and quantitative evaluation by deaf users of:

a. interactive face-to-face transaction systems for use in a Post Office,
b. interactive multimedia: World-Wide Web, and DVB systems,
c. broadcast systems.

Virtual Human signing will be presented to a number of focus groups to elicit feedback on the quality of the virtual human signing. These will be conducted as formal evaluations of the project deliverables of Work Packages 1-5 scheduled as milestones below, and will be used to inform and refine the work of Work Packages 4 and 5.

Description of work

Deaf focus groups will be convened to evaluate the quality of the virtual signing of each in application. For the following styles of communication the respective signing systems will be evaluated for effectiveness:

(i) WWW access
(ii) face to face transactions
(iii) specific TV genres (e.g. monologue commentary, dialogue)

Throughout the project more than 4 entire programmes will be signed, however, it is likely that intelligibility evaluations will employ a large number (>16) programme clips (eg news items). The ITC will work with its digital broadcast licensees with a view to gaining their agreement to the transmission of at least one programme live over-air. This will involve connecting the equipment to the broadcaster's digital multiplex equipment. This broadcast (and probably others) will be received and watched by an audience of deaf viewers. If appropriate the press will be invited to the viewing for the purposes of publicising the work of ViSiCAST. IRT intends to display a running ViSiCAST system on their stand at the International Broadcast Convention (IBC) in September 2002 at the end of the ViSiCAST project. The data will be transmitted via IRT's DVB up-link in Berlin-Potsdam, distributed over the Astra satellite system and received and displayed in Amsterdam.

For video presentations in general (ie not necessarily live off-air), at least 6 controlled focus group

evaluations will be employed together with informal evaluations at least 12 deaf clubs and organisations. These tests will inform the development of the signing systems as well as the evaluation methodology itself.

Responses will be elicited to demonstrate understanding either directly, by the extent of successful use of the deliverable concerned, or indirectly, by eliciting information on the ease of reading and comprehensibility of the signing. Responses will be collated analysed and reported. The periodic evaluation deliverable reports will collate and summarise the various evaluations of specific tools.

It is expected that differing application areas will need to achieve differing standards of virtual signing in order to be judged suitable as fit for purpose. Thus specific standards and quantifiable levels of acceptability are difficult to prejudge. However, evaluation must reflect and represent accurately judgements of the focus groups, as well as identify acceptability and deficiencies of specific system components.

Members of the Deaf community will evaluate the quality of the signing generated by ViSiCAST virtual humans. Feedback from evaluations will be used to improve the system. A number of questions will be addressed: quality, relevance, potential value, ease of reading and interaction with the ViSiCAST virtual human. Previous experience shows that objective measurements are often possible, e.g. the accuracy with which individual signs, and short sequences, are recognised both in isolation and embedded in other phrases. Quantitative comparisons of, for example, signs (and sign sequences) extracted directly from the motion-capture system with those generated from first principles using ViSiCAST-GML will be made. In addition experiments to test the comprehension of virtual signing will be used. For example, the success rate for face to face transactions over the Post Office counter will be measured. More interestingly, the take-up rate, by deaf people who develop web pages, of the tools for illustrating web pages using signing will be monitored.

i) Test television programme signed commentaries for particular domains will be prepared using ViSiCAST-VH for evaluation by the relevant deaf community.
ii) The effectiveness of web-pages that include BSL, DGS and NGT virtual human signing will be evaluated by the relevant deaf community. Subject matter will include entertainment, education and the teaching of sign language itself. In addition, value of the mark-up tools will be assessed together the rate at which they are taken up by Web authors.
iii) Two PO assistants and two deaf users (whose competence in sign language will be known) will assess the separate systems that use, respectively, restricted phrases, unconstrained speech understanding, and have gesture feedback. It is a summative test arranged as an experiment.

Deliverables

6-1	*Evaluation Report 1*	*20*
6-2	*Evaluation Report 2*	*27*
6-3	*Evaluation Report 3*	*35*

Milestones and expected results

Evaluation of Constrained-PO-sys	*delivered month 9*
Evaluation of Unconstrained-PO-sys	*delivered month 21*
Evaluation of Dialogue-PO-sys	*delivered month 31*

Evaluation of interactive multimedia: World-Wide Web, and DVB systems. It is expected that the deaf community will find the ViSiCAST tools for generating useful web pages, that include signing, improve their access to web facilities and learning environments.

Evaluation of GML-Tool-Initial	*10*
Evaluation of Browser-Plug-in	*13*
Evaluation of GML-Tool-Final	*28*
Evaluation of Nat-sign-lang-tool	*29*
Evaluation of Web page-tutor	*31*
Evaluation of GML-edit-tool	*34*

Evaluation of broadcast systems where it is expected that the photo-real ViSiCAST-VH reproduction of real-live human signing will be clearer than the same image delivered through a low bit-rate general purpose video codec such as MPEG-2.

Evaluation of Direct-sign	*11*

Evaluation of text to singing translation systems where it is expected that semi-automatic sign preparation can be achieved in reasonable time by a trained operative delivering comprehensible signed commentaries of the text input.

Evaluation of Proto-text-to-semantic	*20*
Evaluation of Integrated-Edit-env	*36*

B3. Workpackage description

Workpackage number :	**7** Project Management, External Communications and Publicity								
Start date or starting event:	Month 1								
Participant number:	1	2	3	4	5	6	7	8	9
	ITC	IRT	TV	UH	UEA	INT	IvD	PO	RNID
Person-months per participant:	16	1	1	(+2)	(+2)	1	(+1)	1	(+1)

Objectives

Overall project management, including monitoring activities, reporting progress, financial management and co-ordination of project meetings and deliverables.

To publicise the project on the World-Wide Web.

Description of work

This task covers the monitoring and reporting of the progress made by all the participants and the subcontractors in executing the project. This includes the following tasks:

- preparation of monthly progress reports
- identification of unforeseen problems that may impact on deliverables and hence require a change to the project work plan
- monitoring of activities of each participant organisation to ensure that manpower and materials are professionally and efficiently managed in accordance with the work plan
- co-ordination of participants' efforts to ensure maximum efficiency and minimum duplication of effort
- co-ordination of production of contract Deliverables with the participant responsible for each, to ensure that contributions to them are produced on time
- co-ordination of project meetings and recording of minutes
- financial management and control of the project

Deliverables and contractual obligations

Web site production	*3*
Month reports	
Annual reports	*9, 21, 36*

Milestones and expected results

Quarterly consortium meetings

B3. Workpackage description

Workpackage number :	**8**	Exploitation and Dissemination								
Start date or starting event:	Month 1									
Participant number:	1	1	2	3	4	5	6	7	8	9
	ITC	ITC-T	IRT	TV	UH	UEA	INT	IvD	PO	RNID
Person-months per participan	2	1	1	1	1	1(+1)	2	3	1	5

Objectives

Workpackages 1, 2, and 3 will develop practical applications of ViSiCAST technology. Because of the importance that ViSiCAST places upon exploitation and dissemination, each of these WPs contains participants who will become major commercial end-users of the applications being developed, with a specific responsibility for ensuring exploitation and dissemination. Thus much of the exploitation work which would normally be carried out external to a project such as this, will be carried out internally and within application-orientated WPs.

ViSiCAST also recognises that there is a need for wider exploitation and dissemination beyond the members of the consortium, and this is the concern of WP8.

The objective of this Workpackage is to see that core technology is publicised, where appropriate, through academic channels, that generic technology is transferred into new application areas and that specific applications, developed within the project, achieve the widest possible currency and adoption by industry and user groups.

Description of work

The specific exploitation and dissemination objectives of the participants have been summarised in Section 10 of this document. This Workpackage will ensure that these aspirations are met by compiling a detailed 'Exploitation and Dissemination Plan' within the first six months of the project. In conformity with the co-ordinator's guidelines, a detailed 'Dissemination and Exploitation Plan' will be the first deliverable of this Workpackage and will be submitted for approval by the Project Officer. To render transparent those activities elsewhere in the project which have a clear exploitation and dissemination role, the exploitation plan will also spell out the linkages between WP8 and the relevant activities of WPs 1-3. The plan will establish details of exploitation and dissemination work during and beyond the life of the project. The consortium has also been required to produce a marketing study examining such issues as: population sizes and economic status of potential customers, their motivation to buy and use ViSiCAST products, the impact of European disability legislation, the economics of real vs virtual human signing in television, advantages for spin-off applications, etc. This will also be available at the end of month 6.

The strategy of the consortium with regard to activities within the first three years is in place. According to this, the broad objectives of the Dissemination and Exploitation Workpackage within the life of the project are outlined as milestones below.

A Deliverable of this Workpackage will be a Dissemination and Exploitation Report, delivered in three sections – after the first year, after the second year and at the end of the project. It will give details of the exploitation and dissemination activities which have taken place, in accord with the

general structure outlined below. They will also contain cuttings, publicity material, video-tapes of news clips and other coverage, copies of publications in learned journals and papers within proceedings of major academic and industry events. The reports will also cover technology-transfer issues.

A 'Technical Implementation Plan', compiled in the final stages of the project, will establish a procedure for the introduction and application of the developed technologies after the life-span of the project itself.

In line with commonly recognised practice within the software industry – that you can afford to give away only the most valuable software – a version of the signing animation viewer which will be developed in WP2 will be distributed entirely free of charge. This is to meet the social needs of the relatively disadvantaged deaf community. In commercial terms, it will also generate demand, among those who can afford it, for more sophisticated viewers, editing tools and signed animation authoring systems.

Deliverables and contractual obligations

Exploitation-plan	*6*
Marketing study	*6*
Exploitation and Dissemination Report Part 1: Project Awareness	*13*
Exploitation and Dissemination Report Part2: Dissemination of Research	*25*
Exploitation and Dissemination Report Part 3: Towards Product	*36*
Technical-implementation-plan	*36*
Publicity initiatives through the press and academic events	

Milestones and expected results

Year One – Awareness
Publicity and creation of user, market and industry awareness via news media. Exploration of standardisation issues – MPEG 4 and DVB. Demonstration of initial broadcast performance system.

Year Two – Research Findings
Dissemination of emerging research findings through academic papers, conferences and exhibitions. Presentations at research-oriented international trade shows. Publicity relating to extensive trials of retail-orientated and broadcast systems, conducted with co-operation of potential industrial end-users (major retail organisations, TV broadcasters etc).

Year Three – Towards Product
Continued academic dissemination through industrial trials and demonstrations at major international trade shows (for example, the International Broadcasting Convention, Amsterdam). Promulgation of standards. Publicity Launch of 'free to end-user' viewer/browser plug-in (developed within WP2). Presentations to potential broadcast and retail industry users. Marketing of interactive media learning tools.

9.4 Deliverables List (sorted chronologically)

Also included in this and the following table are reports produced to satisfy contractual obligations.

Del. no.	Del. name	WP no.	Lead Partici-pant	Person months approx	Deliverable type	Security *	Delivery (proj. month)
	Web site production	7	ITC	2	Other	Pub	3
	Marketing study	8	ITC	3	Report	Int	6
	Exploitation plan	8	ITC	3	Report	Int	6
3-1	Constrained PO system	3	UEA	6	Prototype	Pub	7
4-1	Proto anim direct TX	4	TV	12	Prototype	Pub	9
1-1	Direct sign	1	IRT	13	Prototype	Pub	12
2-1	Browser plug-in	2	UEA	15	Prototype	Pub	12
5-1	Interface definitions	5	UH	10	Report	Int	12
5-2	GML definition	5	UH	10	Report	Int	15
5-3	Prototype text-to-sign notation	5	UH	46	Prototype	Int	18
6-1	Evaluation report 1	6	RNID & UKPO	10	Report	Pub	20
3-2	Unconstrained PO system	3	UEA	18	Prototype	Pub	22
4-2	Notation avatar	4	TV	38	Prototype	Int	24
6-2	Evaluation report 2	6	RNID & UKPO	10	Report	Pub	27
4-3	Final avatar	4	TV	33	Prototype	Pub	29
1-3	TV specifications	1	IRT	6	Report	Rest	30
2-2	Web page sign	2	IVD	34	Other	Pub	30
2-3	Signing tutor	2	UH	30	Other	Pub	30
4-4	MPEG4 synthetic	4	INT	32	Prototype	Int	30
5-4	Integrated Edit env	5	UH	52	Prototype	Pub	32
1-2	GML sign	1	IRT	22	Prototype	Pub	33
3-3	Dialogue PO system	3	UEA	32	Prototype	Pub	34
6-3	Evaluation report 3	6	RNID & UKPO	12	Report	Pub	35
	Technical implementation plan	8	ITC	6	Report	Int	36
	Monthly progress	7	ITC	10	Report	Int	
	Annual progress	7	ITC	4	Report	Int	9,21,36
	Publicity: press	8	ITC	2	Other	Pub	
	Publicity: academic	8	ITC	4	Other	Pub	

9.4 Deliverables List (sorted by Deliverable number)

Del. no.	Del. name	WP no.	Lead partici-pant	Person months approx	Deliverable type	Security *	Delivery (proj. month)
1-1	Direct sign	1	IRT	13	Prototype	Pub	10
1-2	GML sign	1	IRT	22	Prototype	Pub	33
1-3	TV Specifications	1	IRT	6	Report	Rest	30
2-1	Browser plug-in	2	UEA	15	Prototype	Pub	12
2-2	Web page sign	2	IVD	34	Other	Pub	30
2-3	Signing tutor	2	UH	30	Other	Pub	30
3-1	Constrained PO system	3	UEA	6	Prototype	Pub	7
3-2	Unconstrained PO system	3	UEA	18	Prototype	Pub	22
3-3	Dialogue PO system	3	UEA	32	Prototype	Pub	34
4-1	Proto anim direct TX	4	TV	12	Prototype	Pub	9
4-2	Notation avatar	4	TV	38	Prototype	Int	24
4-3	Final avatar	4	TV	33	Prototype	Pub	29
4-4	MPEG4 synthetic	4	INT	32	Prototype	Int	30
5-1	Interface definitions	5	UH	10	Report	Int	12
5-2	GML definition	5	UH	10	Report	Int	15
5-3	Proto text to semant	5	UH	46	Prototype	Int	18
5-4	Integrated edit env	5	UH	52	Prototype	Pub	32
6-1	Evaluation report 1	6	RNID & UKPO	10	Report	Pub	20
6-2	Evaluation report 2	6	RNID & UKPO	10	Report	Pub	27
6-3	Evaluation report 3	6	RNID & UKPO	12	Report	Pub	35
	Web site production	7	ITC	2	Other	Pub	3
	Monthly progress	7	ITC	10	Report	Int	
	Annual progress	7	ITC	4	Report	Int	9,21,36
	Marketing study	8	ITC	3	Report	Int	6
	Exploitation plan	8	ITC	3	Report	Int	6
	Technical implementation plan	8	ITC	6	Report	Int	36
	Publicity: press	8	ITC	2	Other	Pub	
	Publicity: academic	8	ITC	4	Other	Pub	

*Int. Internal circulation within project (and Commission Project Officer if requested)
Rest. Restricted circulation list (specify in footnote) and Commission PO only
IST Circulation within IST Programme participants
FP5 Circulation within Framework Programme participants
Pub. Public document

9.5 Project Planning and Timetable

The following pages show tables relating the breakdown of effort by Workpackage and the duration of Workpackage effort expended by individual participants throughout the project.

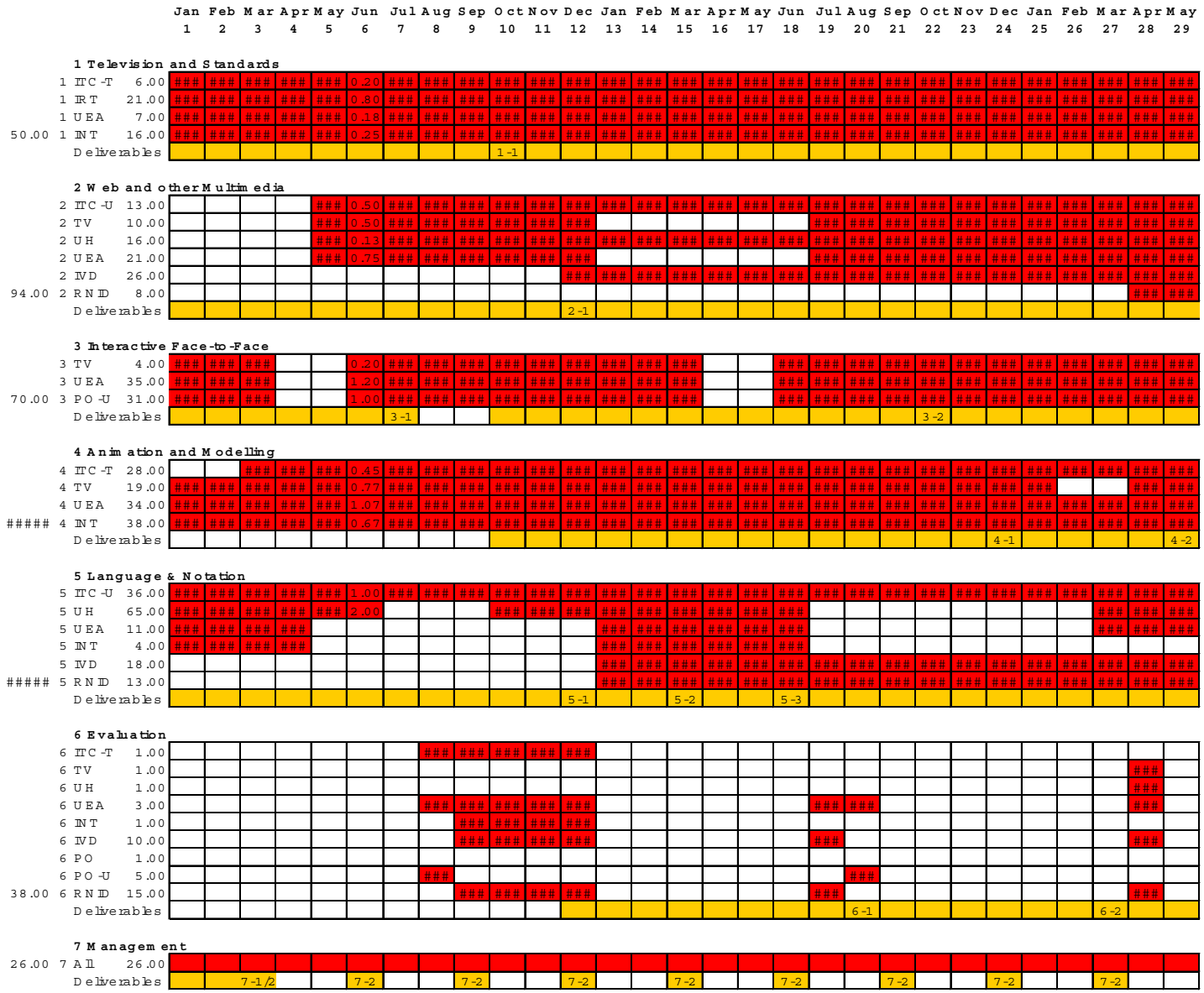
ViSiCAST Workpackages entail parallel on-going developments throughout the 3-year duration so that all three application areas are all at their most advanced at the end of the term. This is why the project also has a relatively large number of deliverables at is end.

Workpackage Effort Levels/man months

WP	ITC	ITC-T	ITC-U	IRT	TV	UH	UEA	INT	IvD	PO	PO-U	RNID	TOTAL
1		6		21			7	16					**50**
2			10 (+3)		10	13 (+3)	16 (+5)		22 (+4)			8	**79 (+15)**
3					4		31 (+4)				21 (+10)		**56 (+14)**
4		28			19		30 (+4)	38					**115 (+4)**
5			20 (+16)			57 (+8)	9 (+2)	4	15 (+3)			13	**118 (+29)**
6		1			1	1	3	1	8 (+2)	1	3 (+2)	15	**34 (+4)**
7	16			1	1	(+2)	(+2)	1	(+1)	1			**20 (+6)**
8	2	1		1	1	1	1 (+1)	2	3	1		5	**18 (+1)**
	18	**36**	**30 (+19)**	**23**	**36**	**72 (+13)**	**97 (+18)**	**62**	**48 (+10)**	**3**	**24 (+12)**	**41 (+1)**	**490 (+73)**

Notes:

(i) Man month figures in parentheses refer to contributions made by 'Additional Costs' participants from their own resources
(ii) In the above table additional participant code designations are introduced for the administrative convenience of the project. Both 'ITC-U' and 'PO-U' mean 'UEA', and 'ITC-T' means 'TV'


Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
1 Television and Standards
1 ITC-T 6.00
1 IRT 21.00
1 UEA 7.00
50.00 1 INT 16.00
Deliverables
1-1
2 Web and other Multimedia
2 ITC-U 13.00
2 TV 10.00
2 UH 16.00
2 UEA 21.00
2 IVD 26.00
94.00 2 RND 8.00
Deliverables
2-1
3 Interactive Face-to-Face
3 TV 4.00
3 UEA 35.00
70.00 3 PO-U 31.00
Deliverables
3-1
3-2
4 Animation and Modelling
4 ITC-T 28.00
4 TV 19.00
4 UEA 34.00
4 INT 38.00
Deliverables
4-1
4-2
5 Language & Notation
5 ITC-U 36.00
5 UH 65.00
5 UEA 11.00
5 INT 4.00
5 IVD 18.00
5 RND 13.00
Deliverables
5-1
5-2
5-3
6 Evaluation
6 ITC-T 1.00
6 TV 1.00
6 UH 1.00
6 UEA 3.00
6 INT 1.00
6 IVD 10.00
6 PO 1.00
6 PO-U 5.00
38.00 6 RND 15.00
Deliverables
6-1
6-2
7 Management
26.00 7 All 26.00
Deliverables
7-1/2
7-2

May 5	Jun 6	Jul 7	Aug 8	Sep 9	Oct 10	Nov 11	Dec 12	Jan 13	Feb 14	Mar 15	Apr 16	May 17	Jun 18	Jul 19	Aug 20	Sep 21	Oct 22	Nov 23	Dec 24	Jan 25	Feb 26	Mar 27	Apr 28	May 29	Jun 30	Jul 31	Aug 32	Sep 33	Oct 34	Nov 35	Dec 36
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###	0.80	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	0.65
###	0.18	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	0.19
###	0.25	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	0.51
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###	0.50	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###						
###	0.50	###	###	###	###	###	###							###	###	###	###	###	###	###	###	###	###	###	###						
###	0.13	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###			
###	0.75	###	###	###	###	###	###							###	###	###	###	###	###	###	###	###	###	###	###						
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	0.20	###	###	###	###	###	###	###	###	###			###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###		
	1.20	###	###	###	###	###	###	###	###	###			###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###		
	1.00	###	###	###	###	###	###	###	###	###			###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###		
		3 -1												3 -2														3 -3		

###	0.45	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	0.75
###	0.77	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###			###	###			###	###			
###	1.07	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	0.50
###	0.67	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	0.88
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###	1.00	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	1.00
###	2.00				###	###	###	###	###	###	###	###	###									###	###	###	###	###	###	###			
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###	0.39	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###	0.39
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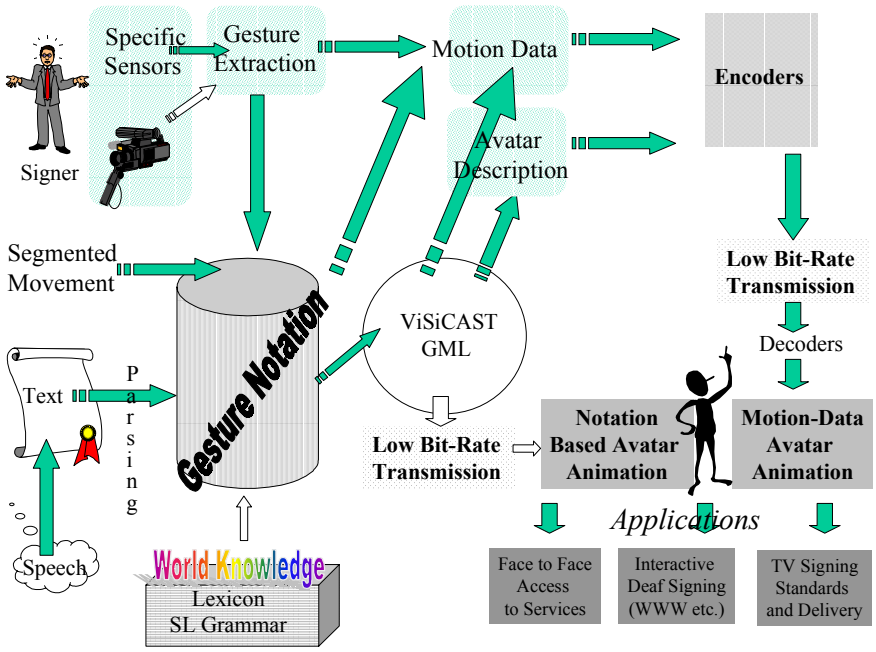
9.6 Graphical Presentation of Project Components

In the above chart, Deliverables are indicated for each Workpackage. Left-to-right dependencies within a package are implicit and between packages are indicated by connecting lines. Packages are arranged so that product/information flow is from left to right and top to bottom, hence enabling technology packages (4,5) feed applications (1,2,3) which are then evaluated (6) by the user community and become available for exploitation (7,8). Interconnections between packages in less formal milestones are omitted for clarity.



The diagram above illustrates the interrelation ships between the different areas of ViSiCAST technology. Its aim is to show how common elements will be developed to satisfy the family of applications.

9.7 Project Management

Project Management: Monitoring, administration and corrective actions

Management of the project will be carried out by a professional and respected Project Manager who has many years experience of directing large-scale national and international projects both with industry and academia. The Project Manager is provided with administrative support through the offices of the ITC, as well as assistance from the ITC's professional accountants who regularly handle large sums of money on behalf of the UK's commercial television companies. The accountants also administer the ITC's Euro bank accounts, put in place specifically to handle support income for European collaborative ventures, and they make payments to participants as and when directed to do so by the Project Manager.

The Project Manager will employ her own preferred PC-based software (most ITC project managers use Microsoft Excel-based systems of their own structuring, which been found to be more flexible for European collaborations than the popular Microsoft Project package) to chart the technical and financial progress of work according to bar charts and timed PERT charts. These latter established project management tools enable any potential timing problems or critical reliances on inter-participant results to be identified. These same tools then allow any corrective actions to be planned in such a way that they have a minimal effect on the project's critical path.

The Project Manager will be accorded significant authority and will be given access, upon request, to all relevant information on technical progress, labour expenditure and financial data concerning project matters from any participant organisation. Furthermore participating organisations warrant that access to such information will not be unreasonably delayed. Where, in the opinion of the Project Manager, re-allocation of resources is required to achieve target dates for Milestones or Deliverables, these re-allocations will be discussed with the participant(s) concerned (perhaps at a quarterly Management Group meeting) and the Project Manager will communicate the proposed re-allocation to the IST Project Officer.

Regular monthly reporting to the Project Manager will be through named individuals in each participating organisation. Such reports will be e-mailed to the Project Manager by the last day of each calendar month, unless notified of any unusual arrangements by the Project Manager. It will then be the responsibility of the Project Manager to compile a concise report for the IST Project Officer showing: the technical and financial status (both for the month concerned and cumulatively) of the project with respect to the Work Plan; any problems encountered; and plans for the coming month. Requests for any changes to the Work Plan will be notified to the Project Officer at this time, with supporting arguments for the proposed action.

Compilation of Annual reports will be the responsibility of the Project Manager, but she will have the authority to request contributions from any partners. Preparation for the Annual Audit presentation will also be the responsibility of the Project Manager but she may choose to delegate substantial responsibility for this preparation as well as the presentations at the Audit hearings.

When notified to do so by the IST Project Officer, the Project manager will co-ordinate production of cost claims, against which the Commission will make interim and final payments.

Communications

Frequent informal communication between all individuals involved in the project will be strongly encouraged. The aim is for every individual to feel part of a virtual community and to be kept aware of all events surrounding both the working and social aspects of the project. The Project Manager will be responsible for fostering intra-project communication and will ensure that items of news reach every participant through an e-mail reflector or telephone call.

Written communication between participants will be by electronic mail and large documents will be distributed via a ViSiCAST ftp Internet site operated by the ITC. Documents of any length for inclusion in management reports or Deliverables will be produced in a recent Microsoft Word format with compatible tables and diagrams. Participants will make every reasonable effort to ensure that written contributions are produced and distributed in a timely fashion.

External communications will be handled by the Project Manager who will have the authority to communicate in the name of the project with: the IST Project Officer, other IST projects, standards bodies, and other professional and commercial organisations which interact with ViSiCAST. The Project Manager will not, however, have sole authority for communicating with charities, lobby groups, or the press, or for handling project publications or publicity. Such communication concerning ViSiCAST (irrespective of the participant to whom the communication may have been addressed) will only be undertaken following consultation with a group of project nominees representing all participants.

The project agrees that is shall participate to a reasonable level in ‘concertation’ activities such as are expected to be defined for the IST programme. The project will be represented by senior participants in the participating organisations and the names of individuals chosen will be decided at the quarterly Management Group meetings.

ViSiCAST agrees to attend or display at exhibitions and conferences requested by officers of the IST programme after signature of this Contract, provided that such attendance or display is deemed by the project to yield appropriate returns for the costs and efforts involved, and provided that financial resources are available within the project (having due regard to the resourcing of the planned commitments to dissemination envisaged in Section 13).

Project structure

The ITC, the co-ordinating participant of ViSiCAST, specialises in the management of research projects and has extensive experience and an established reputation in leading international collaborations. It has contributed to academic and business literature on cross-cultural management, creativity, IPR strategy and structures for R&D projects.

Success in many earlier projects has been achieved through the use of loose and dynamic project structures coupled with the encouragement of a strong social cohesion between individual project members. This is the general approach to be adopted for ViSiCAST. The most recent publications and analyses in international project management journals endorse such approaches. They reduce the bureaucracy and communication difficulties associated with hierarchical fixed sub-group working; they identify faster solutions to unexpected problems; they encourage a rapid response to changes in external technical and commercial environments; and they promote closer and more harmonious working with increased trust. These features have been shown to lead to the achievement of more

ambitious shared goals, increased creativity, a higher likelihood project success and increased shared exploitation of the results.

Flexible management is only practical with small projects and has proven so productive that the ITC no longer supports large collaborative ventures. The flexible approach is underpinned by a single central Management Group, which performs both 'steering' and 'work co-ordination' tasks and which meets at regular 3-month intervals for 2 days. The chairman of this Management Group (who is not necessarily the Project Manager) will be an employee of the ITC and will be a person acceptable to all participants.

Every participant company is represented on the Management Group by a nominated representative, who will not only be a specialist but will also have management responsibility within his/her company (the CV of this person appears within this proposal). He/she will be responsible for progress, and will have the power to commit his/her company to a change in the direction of its work. If required, a second specialist from each participant may attend, and this person may differ from meeting to meeting. It is mandatory, however, that every participant company is represented at every Management Group meeting and that the representative has full delegated authority of the participant's nominee.

Typically, half a day at the meeting will be taken up with administrative issues, while the remainder considers key working papers and demonstrations, and becomes involved in critical and constructive debate concerning results and conclusions, and their implications for the direction of the project. These discussions involve *all* the participants in *all* topics of current interest, and promote a shared understanding and ownership of *all* the work arising from the project. Decisions will be made about the specific direction to be taken over the following 3 months, of the ad-hoc groups currently operating, and the potential creation or termination of such groups. The object will always be to ensure that the project is optimally structured, at any time, to be addressing the key issues influencing the achievement of its goals.

The proceedings of the Management Group meetings will be carefully minuted to record: the attendance, the topics discussed, considerations of progress, suggestions and comments given, decisions made, plans for the coming quarter, actions allocated and completed, and the outcomes of any votes taken. The production of the minutes will be the responsibility of the Project Manager but she may delegate this task to other participants of the Management Group, especially if she is chairing the meeting. Minutes of the Management Group meeting will be produced promptly and distributed via e-mail to all individuals working on the project, and will also be made available, on request, to the IST Project Officer.

The decision-making process

Decisions concerning the direction of the work will be made jointly by all participants, usually at the three-monthly Management Group meetings. Where significant decisions must be made at other times, this action will be co-ordinated by the Project Manager, usually via the medium of e-mail. All participants and subcontractors will make their best endeavours to achieve decisions which are acceptable to all. In the event of a disagreement which is not resolvable by negotiation, a decision will be arrived at by a simple majority vote of participants (ie full contractors), where each has one vote irrespective of its level of commitment to the project. In the event that there is no overriding majority, the decision of the co-ordinating participant will be accepted.

Quality, legal and ethical monitoring

ViSiCAST believes that the deaf community, as users of the technology, should be the arbiters of quality, and throughout the work, critical and scientific evaluation of progress will be undertaken through the auspices of the participants representing the interests of deaf people. Where possible elements of ViSiCAST's work will also be benchmarked against developments (in eg virtual human, linguistic and transmission methods) happening in related industries, to ensure that its participants are always working at the leading edge of the technologies.

All the participants in ViSiCAST have been chosen for their unique abilities to bring the very best of complementary expertise available in Europe to solve some very challenging problems of deaf language communication. These participants will unanimously declare their acceptance of the high quality of all Deliverables and prototypes arising from the work before their submission to the IST Project Officer.

The ViSiCAST project further agrees to appoint external peer reviewers to assess the quality of its principal Deliverables (those considered significant enough to be recommended for presentation and assessment by the Annual Audit reviewers) and overall progress of the project at these times. The intention is to appoint two peer reviewers, one to assess technical issues (software, hardware, linguistics, ergonomics, reliability, etc) and one who represents the interests of users of ViSiCAST products. The peer review reports will be submitted to the IST Project Officer together with a statement from the project addressing the remarks of the reviewer(s) and if appropriate, explaining what actions have/will be taken.

Throughout the work, the Management Group will take seriously its responsibility for the rights, interests and moral expectations of the deaf community with regard to experimental practices, freedom of information, their representation in publicity and ViSiCAST's exploitation plans. Similarly, its legal obligations with regard to such issues as: safety, fair practices, competition law, protection against fraudulent use of EC funds, misrepresentation, infringement of IPRs, and breach of confidentiality, will be carefully observed.

10. Clustering

Not applicable – ViSiCAST is not part of a cluster of projects.

11. Other Contractual Conditions

This Section includes a description of the 'Durable Equipment', 'Computing' and 'Other Costs' requested in the ViSiCAST Electra Financial Plan.

Televirtual - Durable Equipment

A sum of 28,000 Euro has been shown in the Electra Financial Plan for the purchase of computer equipment and peripherals used in motion capture and avatar animation, directly related to the project.

As the leading European resource offering motion capture facilities to commercial clients, Televirtual has a policy of continuous improvement and upgrading of its motion capture equipment. One of the objectives of ViSiCAST, however, is to create a 'user friendly' capture system, capable of being used by non-specialist personnel in an industry setting. The prototype of this system will use some technology existing in-house at Televirtual, upgraded with new software and hardware as the project develops.

It is not possible to be more specific at this stage – as the development of the new system is dependent upon the direction and other developments of the project as a whole. Obviously, expenditure will be reported as it happens and funding will not be claimed unless relevant.

Televirtual - Computing Costs

Outside its research area, Televirtual provides animation and rendering facilities to the animation industry. This very nominal sum – 1,500 Euro over three years – will cover the use of this resource within the project. This will cover such activities as the post-rendering of animated sequences for demonstration purposes and the costs of animation post-production in computer.

RNID – Other Significant Project Costs

The RNID has included 8,940 Euro under the 'Other Significant Project Costs' category to cover the services provided by self-employed interpreters, electronic note-takers and signers. These interpretation and communication facilities are essential to ensure that full access and involvement of deaf and hard-of-hearing staff, participants and representative end-users in meetings, focus groups, test trials and dissemination events.

University of Hamburg – Durable Equipment

The University of Hamburg will hire two persons specifically for the work on ViSiCAST, although this may actually be split between 4 part-time staff (possibly PhD students). It will be necessary to provide two working environments for these researchers.

In common with most sign language institutes, the linguistics software infrastructure at the University of Hamburg is based on a Mac operating system. The primary work stations will therefore be based upon these. Two other Windows-based PCs will also be required at these work stations to act as signing servers.

University of East Anglia – Durable Costs

The UEA will have 8 people working on the ViSiCAST project and have costed 4 lap-top PCs for each to allow flexible use at meetings and for demonstrations.

During the project new sign capture technology will constantly be improved by Televirtual (with some input from UEA and IRT). Other members of the consortium will, however, need frequent access on demand to a reliable and stable system to record signs with the help of signers, translators etc. It would be impractical to rely on the availability of using the research system in Televirtual's premises. The following configuration replicates the current working system: Optical face tracker, magnetic body tracker, data gloves, and server PC. This is the major system cost at about E100,000.

The body tracking system is regarded as a project resource and will be available for other participants to use, particularly the University of Hamburg.

University of East Anglia – Computing Costs

The UEA has included computer networking charges of about E1,500 per PC per year for its 8 staff.

University of East Anglia – Travel Costs

The UEA has budgeted for travel to meetings, concertation activities and about 5 conference attendances outside the EU (usually in the USA).

University of East Anglia – Other Significant Project Costs

The UEA has budgeted E10,300 to cover the cost of the peer reviews of key Deliverables produced by the consortium.

Institut National des Télécommunications – Protection of Knowledge

The INT has a policy of recovering costs associated with the protection of intellectual property and has budgeted E5,518 for this purpose. The consortium understands that this budget cannot be transferred to other expenditure categories.

Institut für Rundfunktechnik – Durable Equipment

IRT will produce a prototype transmission system for ViSiCAST data. This includes multiplex inserter hardware and software as well as a decoder hardware and software. As they are not on the market these devices have to be developed. For this purpose several test equipments are to be needed, eg for testing and analysing the MPEG-2 and MPEG-4 packet data structure. These costs have been budgeted at a total of E30,000.

12. Supplementary Reports and Concertation Activity

During the negotiation meetings for this Contract, ViSiCAST was required to undertake certain activities not explicitly defined in any prior IST documentation.

A marketing study is to be delivered at the end of month 6. This is defined under Workpackage 8.

The project agrees that is shall participate in 'concertation' activities such as are expected to be defined for the IST programme. This is covered in Section 9.7 Project Management.

The project agrees to submit itself and key Deliverables to peer review. This is covered in Section 9.7 Project Management.

13. Background on Exploitation & Dissemination

All the participants and subcontractors within the ViSiCAST project are also themselves potential end-users of the technology being developed. In the application areas (WPs 1, 2, and 3) the relevant end-users (particularly Post Office, ITC, IRT, RNID, IVD, INT) have been closely associated with the individual application under consideration. In the technology areas, participants who will later be involved in technology-transfer issues, dealing with associated areas, are also involved (for example, TV, INT, UH).

Consequently, individual participants will take responsibility for elements of the Dissemination and Exploitation Plan, its drafting and execution, closely related to their own areas of activity. These are summarised below:

Independent Television Commission *(Regulatory authority within the UK and, through its licensees, a potential end user of broadcast signing systems)*

The ITC has a responsibility under the Broadcasting Act 1996 to regulate the provision of signing services on commercial digital terrestrial television in the UK. The UK's commercial broadcasters are the first in the world to have this requirement placed upon them. European legislation now requires that access to all services must be made available to disabled people, and it is therefore to be expected that other European countries will adopt signing services in the not-too-distant future. In the UK, services are due to begin in 2000.

The ITC has a statutory obligation under the 1996 Act to prepare and maintain a code which describes quality and operational criteria for the transmission of signing on digital television. Work and experience from ViSiCAST will be extremely helpful in carrying out this obligation. It also liases with all the organisations in the UK representing the interests of deaf and hard-of-hearing television viewers and will consult with them on developments in signing technologies to ensure that their concerns are carefully considered.

The ITC conducts a large and significant out-sourced research and development programme which takes very seriously the interests of disabled television viewers. As a result of work under the 'Simon-the-Signer' project (earlier known as 'SignAnim'), which pre-dated the formation of ViSiCAST, the ITC already owns intellectual property from 3 years of research work carried out by the UEA and Televirtual. The ITC will actively seek opportunities for the widespread licensing of this technology and agrees to conduct this licensing on terms which are fair and reasonable. Such licensing brings income to support the ITC's research and development programme.

The ITC also represents the interests of the UK's commercial broadcasters on international standards bodies such as ETSI and ITU-R, and is heavily involved in the work of the EBU and DVB. The ITC will promote potential standards for the representation and transmission of virtual human signing systems in these European bodies. Where appropriate it will also work with the consumer electronics industry to ensure that ViSiCAST technology can be implemented into set-top boxes.

IRT *(Research arm of major German broadcasters, themselves potential end users of broadcast signing systems)*

Hearing impaired people are a minority in each community but there is a significantly high number of people who do need aid in perceiving the radio and television programmes. ViSiCAST will provide a solution for television and multimedia services (which may be 'pushed' by the broadcaster as data services in DVB or DAB) or which may be of the 'pull' type, eg by communicating through the broadcasters' web pages. It is to be noted that both delivery mechanisms will soon be inter-linked in the way that cross-references become possible between the broadcast and the internet media content (Examples are: additional background information announced in the electronic programme guide of a broadcast programme and retrieved, by means of a simple mouse-click, through the internet; book-marking of a broadcast programme announced on the Web page for later viewing or recording via the set-top box.).

Combing results of these pertinent RTD projects currently under funding by the EU with the development results of ViSiCAST will lead to dramatically enhanced service opportunities for hearing-impaired people. The IRT will directly disseminate this knowledge to the broadcasters thanks to a close association with them. The IRT regularly publishes RTD results in specialised trade magazines of the broadcast industry and reports regularly at international broadcast conventions word-wide, eg at the NAB (National Association of Broadcasters) Show and Convention in Las Vegas, the IBC (International Broadcasting Convention) in Amsterdam, the International TV Symposium at Montreux, the yearly ECMAST Symposium and others. Through the European Broadcasting Union (EBU), to which IRT is an active contributor in the technical domain, ViSiCAST results will be reported to the 68 active EBU members in 49 countries (Europe from East to West, North Africa, and the Middle East) and to the 49 associate EBU members in 30 countries further afield.

The IRT is a contributor to all major standardisation bodies like ITU-R, ITU-T, ISO (MPEG), ETSI, CEN or SMPTE. In co-ordination with the project participants, standardisation inputs on broadcast aspects of ViSiCAST will be made.

Last but not least, IRT will use the knowledge gained in the ViSiCAST project directly to assist broadcasters in implementing new and substantial aids for the hearing-impaired. Note: The techniques which will be developed within the ViSiCAST project may eventually also be beneficial for people being handicapped in other forms or for non-handicapped people. The local avatar may become the display character of an intelligent agent assisting everybody in using the future integrated broadcast and information technology services.

Televirtual *(SME with a world reputation in the entertainment and broadcast industries, end user and service provider of motion capture and animation systems)*

Development of advanced motion capture tools. Development of industrial-strength systems for use in signing for broadcast applications. Development of run-time software for end users. Transfer of generic motion capture and animation technology into other industry sectors (video games, entertainment, live performance). Development of generic (ie. Not restricted to signing) animation plug-ins for Web browsers

University of Hamburg *(Academic institution with a recognised world-leading position in deaf studies and linguistics and close operating links with other academic institutions in the field, for*

example, in the UK, Bristol University and University College, London)

Dissemination of Discourse Representation scheme to academic and other users. Dissemination of tools to user groups, particularly in Germany.

University of East Anglia - School of Information Studies *(Academic body with strong reputation and high academic standing based on its research work. Representation on MPEG 4 & 7)*

Dissemination of Linguistic findings to academic and other users. Development of industrial strength retail systems. Development of MPEG standards and applications.

INT *(Research arm of French telecommunications industry. Representation on MPEG 4 & 7 institutions)*

INT is an academic research organisation which develops technology for the telecommunications industry. It aims to publicise virtual signing technology within this industry as well as exploring the refinement of MPEG-4 systems to represent and convey deaf signing at an intelligible quality. INT will actively protect intellectual property arising from its work within ViSiCAST and will licence it.

IvD *(Dutch National Institute with reputation for deaf studies and research)*

Development of interactive learning tools. Dissemination to user groups – particularly in the Netherlands.

The Post Office *(The UK's national postal carrier, one of the largest retail businesses in the world, with an active research arm developing new technologies for use in its outlets)*

It is the intention of The Post Office to exploit the technology arising from the ViSiCAST both in its capacity as service provider and employer. It is envisaged that the interactive avatar system in Post Offices will improve access to services and information for deaf and hard-of-hearing people. It is also our intention to use the same system to perform translations into several European and Asian languages: French, German, Italian Spanish, Welsh, Japanese, Somali and Punjabi. This will enable The Post Office to ensure the widest possible take up of the system within its network, thus maximising the availability of the sign language avatar.

The Post Office is increasing the services and information that can be accessed at kiosks and over the Internet; we would therefore intend also to implement non-interactive avatar technology in order to ensure that the transaction or information is relayed with clarity.

The Post Office also realises the necessity for creating a working environment that is conducive to recruiting and retaining deaf people in its workforce. It is therefore also intended to use interactive avatars in the workplace, first in circumstances where it is vital that information is relayed with optimum clarity and in confidence, such as exchanges with the doctors in our Employee Health Service. It is envisaged that this implementation will be extended to interviews, appraisals, training and coaching.

The Post Office is also an active force within the community, for example our training group recently produced a set of signed videos for children. We envisage that we would also use this technology to promote knowledge and awareness of sign languages within the community.

RNID *(UK National Institute with a strong reputation for providing services and technology to deaf people)*

Trials with and Dissemination to user groups – particularly in UK Involvement of deaf people at all stages. The RNID is the UK's principle supplier of relevant technology to deaf groups and individuals.

Appendix A - Consortium description

All members of the ViSiCAST consortium have been working with the deaf people and/or on synthetic sign language systems for a number of years. ViSiCAST is a mix of public bodies, academic institutions and commercial interests, all with extensive experience of collaborative projects.

The ViSiCAST consortium will be led and co-ordinated by the UK Independent Television Commission (ITC). The ITC is the public body responsible for licensing and regulating commercially funded television services provided in and from the UK, including digital terrestrial television, which has a legal requirement for sign language transmission. The ITC has a long track record of participation and co-ordination in European collaborative projects.

Germany's Institut fuer Rundfunktechnik (IRT) is the research and development body of the public broadcasting authorities in Germany (ARD and ZDF), the Austrian Broadcasting Corporation (ORF) and the Swiss Radio and Television Corporation (SRG). Within ViSiCAST, IRT will be responsible for transport protocols for the transmission of sign language, the development of necessary hardware and field testing with German broadcasters.

Televirtual is an advanced entertainment technology company, with special expertise in the areas of digital animation, virtual reality characters, motion capture and environments. The company was also one of the original three participants in the 'Simon-the-Signer' project, within the ITC's R&D programme, which developed a prototype system to convert a textual input (such as teletext) to synthetic virtual human signing. Televirtual dealt with real-time animation and modelling issues: the linguistic problems of translating text, prepared in standard English, into the different grammatical and syntactical structures used by sign-supported languages were addressed by the School of Information Systems at the University of East Anglia, UK (UEA).

The UEA is a well-established UK academic institution with an internationally recognised research reputation, with nearly ten thousand students, a fifth of them post-graduates. The University philosophy has always encouraged inter-disciplinary study and research: its School of Information Systems has the requisite expertise in computational linguistics, computer graphics and imaging, and speech recognition.

The Artemis project of the French Institut National des Télécommunications (INT) is a research unit covering the broad spectrum of visual information processing. With its specialised knowledge of MPEG standards, INT will explore ways of using them for the transmission of the virtual signing information. With Televirtual, INT will also look at ways of streamlining the motion and shape capture systems.

The Institute of German Sign Language and Communication of the Deaf at the University of Hamburg has been studying the linguistics of sign language for many years. Its HamNoSys notation, developed to describe the hand gestures of sign language will be expanded to include facial expression information and converted to a machine readable format. This will be used, with an interim language, currently envisaged as written in XML and developed by the UEA and INT, to enable translation between text and sign.

The Netherlands' Instituut voor Doven (IvD) works with deaf children and adults. Its mission is to integrate and emancipate deaf people in society. It, and the University of Hamburg, will work on the development of multi-media learning tools based on the virtual signing system. This will include a Web browser plug-in allowing the dynamic translation of text.

The Royal National Institute for Deaf people (RNID) is the largest organisation supplying services with and for the deaf in the UK. It will supply ViSiCAST with expertise on British Sign Language and will also liaise and evaluate systems with deaf people.

The UK Post Office is an end-user of the face-to-face system being developed within the project. It will provide a test bed for trials of the system, both with the public and with the many deaf people in its employment. The Post Office will also provide information in the requirements of a system designed to operate in a public retailing environment.

Description of the participants

Independent Television Commission, UK (ITC: Co-ordinator)

Organisational Profile

The Independent Television Commission (ITC) is the independent public body responsible for licensing and regulating all commercially funded television services provided in and from the UK, whether analogue or digital. These include Channel 3 (ITV), Channel 4, Channel 5, public Teletext and a range of cable, local delivery and satellite services. The ITC was formed on the 1st January 1991 to operate as a successor to the Cable Authority and the Independent Broadcasting Authority. Within the ITC's Engineering Division, the Standards and Technology department carries out long-term research and development for the benefit of viewers (especially those with sensory impairments), of all the commercial television companies, and to support the regulatory role of the ITC itself. It also has a responsibility for ensuring efficient use is made of the electromagnetic spectrum and it supports international standardisation of broadcast technologies (currently in ETSI (and DVB), ITU-R and DAVIC).

The legislation which established the ITC does not allow it to operate its own laboratories, but instead determines that it should work through contract arrangements and joint ventures with a host of media and technology companies and universities. It specialises in project management and maintaining an awareness of the strategic direction of technological advancements for its licensee companies. Although the ITC's research programme is primarily aimed at advancing technology, its research programme currently employs psychologists, gerontologists, sociologists, linguists, graphics artists, economists, cartographers and a photographer as well as the more usual engineers and computer scientists. This gives a significant ability to investigate media production, service provision, economics and the interests of the viewing community, all of which are essential components in developing and assessing opportunities in new media.

The ITC has been remarkably successful as an innovator of new services and technologies. In the early 1990's it developed with NTL (now NDS) the fundamental technologies necessary for digital terrestrial television, carrying out the first UK broadcasts in January 1993. In early 1992 the ITC formed the European Audetel consortium which developed all the requirements for audio described television for visually impaired people. It was the huge success of this initiative which encouraged the UK government to mandate its carriage on an increasing proportion of digital terrestrial TV, beginning in 1999. Working with participant companies in Germany and the Netherlands, the ITC and NTL also made significant contributions to the wide-screen PALplus system through the European Eureka programme.

Arising out of work in PAL enhancement, the ITC championed the development and world standardisation of a ghost cancelling system for analogue television. The early 1990's saw the organisation heavily involved in the RACE dTTb project and in the foundation of what became DVB. It also operated the RACE MOSAIC project, making fundamental strides in methodologies for measuring the subjective quality of digital television pictures and was a member of RACE HAMLET examining fundamental coding methods for hierarchical HDTV transmission. Working with Vistek (now Barco) and Digital Vision of Sweden, the ITC contributed its knowledge to one of Europe's first MPEG-2 HDTV codecs.

In more recent times the ITC has managed and led three collaborations under the ACTS programme: INTERACT, MIRAGE and TAPESTRIES. These projects have been supported by a large number of ITC research contracts and have successfully addressed a bewildering diversity of technologies: interactive return channel technologies for cable, DECT and terrestrial broadcasting using DVB channels; virtual studio technologies; stereoscopic television production; virtual studio creation and editing tools; programme production in shared virtual environments; virtual human TV presenters; precision camera motion heads; development of visual models for automatic picture quality monitoring; isolated environments and methodologies for the study of psychological immersion; quality evaluation methods for electronic cinema, multimedia and MPEG-4; and head-mounted displays.

Current research activities include: design of interactive TV systems for elderly people; an interactive DVB-compliant 40GHz MMDS services trial in SE England (as leaders of the COMUTE-I consortium); in-home server development with intelligent agent-based viewing advisor; 3D scene capture technologies; perceptual distortion in stereoscopic imagery; satellite coverage prediction; wireless in-home network study; immersive television; virtual human deaf signing; surround audio; psychology of presence; immersive virtual studio development; and speech enhancement in noisy broadcasts to assist the hard-of-hearing (DICTION consortium).

The ITC has won many awards for its research and development including four national broadcasting R&D awards from the Royal Television Society. Last year this award was jointly awarded to the ITC, Televirtual and the UEA for the pioneering work on virtual human deaf signing.

CV of Key Personnel: Dr. Nicolas Lodge

Nick Lodge has worked at the leading edge of television and new media technology for 17 years. In this time he has contributed to many European research and standardisation activities covering a wide range of technologies including: satellite broadcasting, encryption, HDTV, image compression, segmentation, digital terrestrial TV, visual modelling, audio description, virtual studios and immersive TV. In 1991 he joined the ITC, soon becoming head of its Standards & Technology department. In this role he established and still leads, a major programme of R&D and standardisation carried out for the strategic benefit of all the UK's commercial TV companies. Nick has a PhD in digital TV technologies and an MBA in which he specialised in managing the creation and exploitation of innovative technologies. He is a Fellow of the Institution of Electrical Engineers and the Royal Television Society.

Mrs Jan Dobson – ViSiCAST Project Manager

Jan Dobson is the Project Manager responsible for broadcast multimedia at the ITC managing R&D projects and participating in the establishment of new technical standards regarding broadcast multimedia systems and advising on teletext matters. Jan studied Product Design at Kingston University and gained her masters at the RCA in Design Research and Ergonomics. From 1986-95 she was Director of her own ergonomics and systems design consultancy. In 1995 she was invited to head the IT department at Cricklade College where she had been a visiting lecturer. She has contributed to and written books on ergonomics and software design. More recently Jan has been Director of the Creative Technologies Centre at Bristol University where she ran several major industry based, media technology R&D projects including the instigation and management of the Bristol Creative Technology Network an advanced broadband network.

Institut für Rundfunktechnik GmbH, D (IRT)

Company Profile

The Institut für Rundfunktechnik GmbH (IRT) is the research and development centre of the public service broadcasters in Germany (ARD, ZDF, DLR), in Austria (ORF) and in Switzerland (SRG/SSR). The IRT is a non-profit making company. It was founded in 1958 and employs about 200 persons.

The R&D work is managed within five business areas:
- Audio
- Television
- Broadcasting Coverage
- Collaborative Research
- R&D Services

All necessary supportive functions such as a powerful central computer system, drawing, printing and craftsmen workshops are available. The IRT regularly co-operates with industry, universities and other broadcasters in national and international R&D projects. The IRT has been involved in projects like DAB-CATV, DVB-T, Cinenet, Corvette, Custom TV, DVP, Ecortis, HuMIDAB, Hypermedia, Mosquito, Motivate, NADIB, Unitel-2 or Validate.

The IRT sees its role as that of a technical advisor to broadcasters as well as a body for industry to contact with technical questions related to broadcasting. IRT's work encompasses both operation-related and new systems development including spectrum management.

The work is carried out on the basis of annual work plans. The results are reported in an annual review report as well as in numerous technical publications (national and international) and at various scientific symposia. The IRT also issues a scientific/technical periodical: "Rundfunktechnische Mitteilungen" which appears four times a year.

IRT has, together with CCETT, developed the MUSICAM sound coding system, now standardised in MPEG-1 and, as surround sound, in MPEG-2 Layer 2. Within the successful RACE HD-SAT project, led by Alcatel Espace, the IRT built the World's first MPEG-2 video codec switchable from HDTV to 4 times SDTV (incl. multi-channel surround sound). It also built a 20-GHz satellite transponder simulator, a 20-GHz transportable receive station, a TCM-8PSK modem for 140 MBit/s and another one for variable data rates (40 - 70 MBit/s). Pertinent transmission studies for cable, satellite and terrestrial services incl. studies and experiments on signal equalisation were carried out. The IRT has also contributed to the RACE projects dTTb and DISTIMA as well as to the EUREKA projects DAB and VADIS.

The IRT participated in the international ACTS projects DVP, QUOVADIS, VALIDATE and CINENET. Within the 3rd ACTS Call, the IRT is participant in the ACTS projects MOTIVATE and MOSQUITO, Hypermedia and - as project co-ordinator - in CustomTV.

The IRT is heavily involved in the technical work of the EBU (the European Broadcasting Union) and is a contributor to all major standardisation bodies like ITU-R, ITU-T, ISO, ETSI, CENELEC, SMPTE, MPEG or DAVIC.

CVs of Key Personnel: Dipl Ing Christoph Dosch

After graduating from the Technical University of Munich in 1976, Christoph Dosch joined the IRT. Since 1996, he has been General Manager "Collaborative Research ", reporting to the Director. He has been involved in many aspects of analogue and digital satellite sound and television broadcasting, and led several satellite broadcasting projects. He was IRT's co-ordinator for the HD-SAT project (ACTS RACE 2075, 1992 - 1995).

He is active in the ITU and in the work of the EBU Technical Committee. He is Chairman of EBU Project Group B/SVP and Vice-Chairman of ITU-R Working Party 10-11S. In ITU and EBU he is involved in standardisation of new broadcasting systems and represented broadcasters' interests in WARC-BS 77, WARC-ORB(85)/(88), WARC-92 and WRC-97. Recently, he has turned to networking and multi-media applications with special emphasis on inter-working and open system architecture. He is a member of VDE/ITG and FKTG.

Dipl Ing Werner Brückner

Werner Brückner (49) has been employed at IRT since 1981 as Development Engineer. He currently works in the team of the Information & Data Service section. During the last years he has been working on various forms of data broadcast systems which are transported within the television signal (carrying both program and non-program related data). He substantially contributed to the upgrading of classical Teletext to the modern level 2.5 service (which allows graphical representation and 16:9 format. He participated in an international standardisation team of EACEM, Working Party 1.4. He is also busy on systems like TeleWeb and ATVEF and he is an active member of the HTML-standardisation group of DVB/MHP. He is focusing on themes around data-broadcast and the Web.

Televirtual, UK (Televirtual)

Company Profile

Televirtual is an advanced entertainment technology company, with special expertise in the areas of digital animation, Virtual Reality characters, motion capture and environments. The company operates Europe's most advanced independent motion capture studio as a service to animators, video games designers and broadcasters.

Since its creation in 1992, Televirtual has quickly risen to become the UK leader in the creation and manipulation of high quality Virtual Humans, particularly in the broadcast sector. Ratz the Cat, developed for Children’s BBC, was the world’s first on-screen, performance animation TV presenter. Ratz was developed under licensed US software and ran on a high-end Silicon Graphics workstation, using facial gesture recognition technology.

The company went on to develop its own advanced performance animation systems. ‘Impersonator’ is a VR package which animates 2D or 3D images with sound to lip-synch animation in real time on a PC. Impersonators have appeared on the BBC, ITV and other broadcast services around the world. ‘Mask VR’ combines motion capture recording and editing tools with advanced real-time or post-

rendered performance animation output. The company was a full member of the EU Acts project Mirage, investigating aspects of virtual studio, virtual characterisation, and stereoscopy. The company also has a virtual reality environment building section, principally engaged in the development of heritage based attractions.

Televirtual is also one of the two participants in the 'Simon-the-Signer' project, carried out for the UK Independent Television Commission, which developed a prototype system to convert a textual input (such as teletext) to a synthetic head and hands animated image, generating sign language for the hearing-disabled. The project deals with real-time animation issues and the linguistic problems of translating text prepared in standard English into the different grammatical and syntactical structures used by sign languages. The other participant is the School of Information Studies at the University of East Anglia, UK.

Televirtual was originally owned by Broadsword Television, Anglia Television and an independent shareholder. Through a series of corporate take-overs, it became, for a while, part of the large United News and Media group. In 1998, the controlling interest was acquired by Broadsword Television, effectively ensuring that both proprietorship and day to day management of the company rest with the directors who have run it successfully since 1972. Televirtual now qualifies as an SME.

CVs of Key Personnel:

Mr Mark Wells BA (Hons), Research Director,

As Televirtual's Research director, Mark Wells is the company board member with responsibility for management of R&D projects. A BBC-trained TV director, producer and news-producer, he also supplies input on industry requirements and expectations for broadcast related projects. He is a member of the British Machine Vision Association. He previously managed Televirtual's involvement in the EU ACTS project MIRAGE, particularly taking responsibility for production and demonstration issues. He is also qualified as a print-journalist, with the UK's NCTJ certificate. He has an upper second class honours degree in Political Theory and Institutions from the University of Liverpool.

Dr. Marcus Tutt, Head Computer Scientist

Dr. Tutt gained a First Class honours degree in Computer Software Technology at Bath University, UK, in 1995. He then took a Masters Degree in Cognition, Computing and Psychology at Warwick University before moving to the University of East Anglia to complete a PhD in the Visual Simulation of Combustion Phenomena. Initially employed at Televirtual as the Senior Computer Scientist engaged on the EU ACTS project, MIRAGE for the last two years he has been the company's Head Computer Scientist, responsible for technical aspects of research and development, motion capture, virtual human animation and software development. He lead the team which over two years created Mask-VR, Televirtual's state of the art human modelling and animation system. He programs in a number of languages, including C++, and can use a variety of graphics packages.

Dr Sanja Rankov, Senior Computer Scientist

Sanja Rankov was formerly a research assistant at the University of Newcastle, working on virtual

reality related projects. She joined Televirtual in June 1999.
Academic History: PhD University of Newcastle and University of Hull in Visual, Tactile and Kinaesthetic Feedback in Virtual Environments,
BEng (1st Class Hons), Leeds Metropolitan University, 1995. (Combined Studies, Electrical and Electronic Systems, Engineering and Computing).

Mr Mike Dawson BA (Hons), Head Animator, Televirtual

Mike Dawson has been Head Animator at Televirtual since joining the company in 1996. He has been responsible for the animation of 3D computer generated characters for a number of prestige clients, including ITV and the BBC. Previously he worked at Back's Electronic Publishing, Norwich, as a CG designer.
Academic History: BA (Hons), Norwich School of Art and Design, 1995
HND, Graphic Design, Norwich School of Art and Design, 1993.
Member of the Society of Typographic Designers.

University of Hamburg, D (UH)

Organisational Profile

Institute of German Sign Language and Communication of the Deaf

In 1987, a number of research activities regarding the recognition of German Sign Language as a language in the linguistic sense of the word, led by Prof. Dr. Siegmund Prillwitz, resulted in the establishment of a Centre for German Sign Language and Communication of the Deaf within the Department of Languages at Hamburg University. Larger research projects, funded by both national and international bodies, have been successfully completed in the areas of language research, child language development, bi-lingualism, sign language lexicography, multimedia applications, and development of teaching materials for sign language. Since 1992, Hamburg University offers regular study programmes on Sign Language (MA and PhD, very much in line with programmes for other languages such as English or Russian) as well as Sign Language Interpreting (Diploma). In 1997, the Centre was promoted a full institute within the Department of Languages and hence changed its name to 'Institute of German Sign Language and Communication of the Deaf'.

From the beginning, all research projects as well as the curriculum development were joint activities of deaf and hearing staff; today more than half of the staff are deaf. Out of the 58 employees of the Institute, 18 have permanent positions (including 3 professors and 3 deaf lecturers), the others work within third-party funded projects. These projects include Forum within the EU HORIZON programme and SigningBooks within the EU TAP-DE programme.

As this institution was the first research team on sign language in Germany, it is not a surprise that the majority of German publications in the field is from Hamburg. However, research undertaken by the institute is also internationally recognised. Major international conferences organised by the Institute are the 1989 Third European Congress on Sign Language Research, the 1990 International Congress on Sign Language Research and Application, and the 1993 Congress on Deaf History. The Hamburg Notation System for Sign Language is, according to [1], the most widely used system for transcribing signs in the research community. In 1998, the Institute organised the first international

workshop on Sign Language Lexicography, also funded by the German National Science Foundation. The Institute is a member of the European Science Foundation Network Intersign.

[1] Miller, Christopher, 1994, 'A note on notation', *Signpost* - the newsletter of the International Sign Linguistics Association, **3**, 7, 1994, pp. 191-202

CVs of Key Personnel: Prof Rolf Schulmeister:

Rolf Schulmeister studied German and English Philology and Linguistics at Hamburg University, completing his Ph.D. in 1970. In 1970, he founded the Interdisciplinary Centre for Higher Education at Hamburg University, where he was appointed Professor for Higher Education: Learning Methods and Technology in 1976. His major works in Higher Education comprise orientation units, staff development, curriculum revision in psychology and mathematics as well as multimedia learning systems. In 1987, he was co-founder of the Institute for German Sign Language and Communication of the Deaf within the department of Linguistics at Hamburg University. His major works in this contexts are the development of electronic dictionaries for sign language, a learning program to learn how to transcribe sign language visually on the computer (was awarded the German Software Award in linguistics in 1990). He currently works on a multimedia programme to learn German sign language. Furthermore, he is responsible for the Forum project within the EU HORIZON programme. The most often cited one of his recent publications is: Grundlagen Hypermedialer Lernsysteme. Theorie - Design - Didaktik. (Hypermedia Learning Systems: Theory, Design, Didactics) Addison Wesley: Bonn, Paris 1996; 2nd revised ed. Oldenbourg: München 1997.

University of East Anglia, UK (UEA)

Organisational Profile

The University of East Anglia is a traditional campus university located in parkland on the outskirts of the fine medieval city of Norwich and committed to excellence in teaching and research. UEA is made up of 16 Schools of Study which cover subjects spanning the humanities, social sciences, science, and professional disciplines. The student body numbers around 10,000 of whom 2,000 are engaged in postgraduate study.

Interdisciplinarity has been a key aspect of the University since its foundation in 1963. Participation by UEA in the ViSiCAST project will involve the School of Information Systems which represents a seamless integration of the two major constituent disciplines of Information Technology - Computing Science and Electronics.

The School currently has a membership of approximately 500, comprising undergraduates, more than 80 postgraduates registered for MSc, MPhil and PhD degrees, 15 researchers, 27 academic staff, and a similar number administrative and technical support staff. The School has a vibrant and developing research culture which draws on the strengths of classical computer science, electronics and related disciplines to create new ways of making information technology useful to society.

A key theme permeating the School's research is the study, development and application of techniques for collecting, analysing and processing data. This mission is applied in practically

relevant contexts ranging from speech and image analysis, through data mining and optimisation to information and knowledge management.

This unified approach contributed to success in the most research assessment exercise conducted by the UK Government in 1996, which recognised the national and international excellence of our research. Funding from external sources is running at a rate in excess of £1M per annum. The research strengths of the School are in image, speech, and signal processing; mathematical algorithms and computational models; distributed information systems; and computer graphics and computational geometry.

Contributions to ViSiCAST will come from specialists in broadcasting and multimedia, computer vision, computational linguistics, and systems engineering. UEA is a participant with Televirtual in the award-winning 'Simon-the-Signer' project carried out for the ITC, which provides a platform on which ViSiCAST will build. A further project involving Post Office Counters Ltd is combining speech input with recognition of a constrained set of phrases which are translated to other languages including signs.

The School of Information Systems is a participant in a number of existing Framework projects, of which the major ones are: The ACTS integrated broadband communications project: IBC on Broadcast Networks; ETHOS: European Telematics Horizontal Observatory Service; and IACS: Interoperability Assessment in Cable Systems.

CVs of Key Personnel: Prof Andrew Bangham

Prof. J. Andrew Bangham received his PhD in 1994 from University College London. More recently he has been a Senior Lecturer (1992) and then Professor of Information Engineering (1998) at the University of East Anglia. His past work has included a popular statistics computer package (1984) over 100 research papers latterly in the area of computer vision. In this area he holds several patents on new methods for segmenting and analysing images. He has been principal investigator on government, charity and commercially funded research programmes. In particular, the Simon-the-Signer programme, co-ordinated by the Independent Television Society, that received a Royal Television Society Award for Research and Development (1998) and forms the starting point for ViSiCAST.

Dr John Glauert

John Glauert received his PhD from the University of Cambridge in 1984. After working on language design and implementation for the Manchester Dataflow Project when he was one of the authors of the SISAL language, he moved to UEA as Lecturer and then Senior Lecturer from 1991. He is currently Dean of the School of Information Systems. His interest in parallel computing and languages led to active participation in the ESPRIT II TIP European Declarative System and in theoretical work on graph rewriting through SemaGraph, an ESPRIT II Basic Research Action and Esprit III Working Group. He has also participated in the MEDCAMPUS programme and an INCO Keep In Touch project. His expertise in computer languages and notations will be used within ViSiCAST in the development of Gesture Mark-up Language.

Dr Ian Marshall

Ian Marshall is a graduate in English and American Studies (Linguistics) and Computer Studies

(Artificial Intelligence). During the early 1980s he worked as a research associate on the Lancaster Oslo Bergen corpus based approach to linguistics at Lancaster, before lecturing in computer science at Leicester Polytechnic (now De Montfort University) and the University of East Anglia (UEA). In 1997 he completed his PhD 'Hardware Synthesis from an Interval Temporal Logic' and most recently has been involved in the ITC-co-ordinated investigation of natural language processing techniques and virtual humans for deaf signing carried out by UEA and Televirtual.

Dr Stephen Cox

Stephen Cox holds an honours degree in Physics and Music, an MPhil in Cybernetics and a PhD in speech recognition. From 1980 to 1984 he was a Higher Scientific Officer at HM Govt. Communications Centre where he did research into audio signal processing. He joined British Telecom Research Laboratories in 1984 where he worked on developing and assessing speech recognition. From 1987-1989, he was on secondment at the Speech Research Unit at DRA, Malvern where he researched adapting hidden Markov model (HMM) based speech recognisers to the voices of new speakers. He returned to BT Labs in 1989 to head a group that was developing robust speech recognition algorithms for use over the telephone network. After being appointed lecturer in Electronic Systems Engineering at UEA in 1991, he continued research into speaker adaptation algorithms, speech technology reference standards and audio-visual speech recognition. In 1994, he was invited to work in the Speech Research Group at AT&T Bell Labs, New Jersey and spent six months working on the development of techniques for estimating measures of confidence in the output from speech recognisers. He was appointed senior lecturer at UEA in 1998. He is a member of the Institute of Acoustics (IoA) and is Chairman of the IoA Speech Group.

Dr Ralph Elliott

Dr Ralph Elliott received his first degree, in Mathematics and Philosophy, in 1972 from the University of Cambridge. For the remainder of the 1970s he worked in software development before moving to UEA Norwich to work as a research assistant on a variety of projects in the 1980s. Following on from his participation in the Alvey-sponsored Trailblazer project, he received a PhD in 1990 for work on the use of Occam and temporal logic in hardware synthesis. Since then he has been a lecturer in the School of Information Systems at UEA, with particular interests in formal methods and software technology.

Institut National des Télécommunications, F (INT)

Organisational Profile

The ARTEMIS (Advanced Research and TEchniques for Multidimensional Imaging Systems) Project Unit is a research-oriented structure within the Institut National des Télécommunications (INT) — one of the three main components of the French *Groupe des Ecoles de Télécommunications* (GET). Its vocation is to conduct methodological and technological research in the field of multidimensional imaging. ARTEMIS jointly aims at developing a high-level expertise through exploratory projects on advanced topics, and at transferring this competence into operational applications via pre-competitive projects. Research training is active, as illustrated by five defended PhD theses during the 1996-1999 period and eight PhD works currently under continuation.

ARTEMIS activities cover the broad spectrum of visual information processing, including image acquisition, processing, archiving, transmission, analysis, manipulation and secured intelligent access. They are structured in eight projects, organised around three themes:

Multidimensional Vision: The theme is divided into two projects. The *Smart sensors* project focuses on visual sensing systems design and architectural integration of analysis functionalities on visual sensors. Two families of sensors are investigated: conoscopic interferometric sensors for industrial inspection, and programmable artificial retinas for computer vision. The *Non-rigid evolutions* project aims at devising mathematical models of deformable shapes, non-rigid motions and multi-scale analysis in multidimensional images. Emphasis is set on variational optimisation, differential geometry and partial differential equations, with application to medical imaging and fluid motion analysis. Industrial partnerships involve Thomson CSF and Optimet.

Medical Imaging: This theme is divided into three projects with well-defined clinical objectives. The *Heart* project is a joint action within the French *Information, Signal, Image and viSion* (ISIS) research network. It aims at constructing an anatomically-realistic volumic and dynamic model of human heart through analysis/synthesis from multimodal images. ARTEMIS contribution concerns scale-space filtering, variational segmentation and wall deformation analysis in Magnetic Resonance Imaging (MRI) and tagged-MRI sequences. The *Vessels* project is concerned with 3D vascular reconstruction and 3D stenosis quantification from MR Angiography data. Finally, the *Lung* project deals with identification/quantification of respiratory chronic diseases, and 3D reconstruction of bronchial tree in CT imaging. Industrial and institutional partnerships involve General Electrics, Siemens, Elscint-Picker, and INSERM, respectively.

Telecommunications & Multimedia: This theme, divided into three projects, aims at developing enabling technologies for new generation telecommunication services. The *Advanced compression methods project* is concerned with mathematical modelling for lossy/nearly-lossy compression of multispectral data, video object-based selective coding and 2D/3D mesh scalable coding. Emphasis is set on wavelet theory, mathematical morphology and nonlinear information theory. The *Smart shapes* project deals with 3D model-based analysis/ synthesis of video sequences. The interest is focused on facial and gestural analysis for MPEG-4 compliant vision-based natural interfaces and telecommunication services. In a close interaction with the MPEG-7 normalisation process, the *Indexation* project studies metadata description languages, generic description schemes and robust descriptors for content-based retrieval in video and 3D object databases. Industrial partners are France Télécom, Alcatel and CNES.

CVs of Key Personnel: Prof Françoise Preteux

Françoise Prêteux graduated from the Ecole des Mines de Paris and received the Thèse d'Etat in Mathematics from the University of Paris VI, in 1982 and 1987, respectively. Since 1994, she has been a Professor at the INT where she was the Head of the Signal & Image Processing Department until December 1998. She is currently the Head of the ARTEMIS (Advanced Research TEchniques for Multidimensional Imaging Systems) Project Unit. She is the author or co-author of over 60 scientific papers within the field of stochastic modelling and mathematical morphology with applications to pattern recognition, medical imaging, and non-destructive testing. She is now mostly involved within the field of multidimensional imaging with emphasis on 3D modelling, indexing techniques and digital image coding. She is Deputy Head of the French Delegation for MPEG-7 and an active contributor to core experiments of the MPEG-4/SNHC Group.

Dr. Nicolas Rougon

Nicolas Rougon received an Engineer Degree in Telecommunications and a PhD in Signal and Image Processing from the Ecole Nationale Supérieure des Télécommunications (ENST), Paris, France, respectively in 1989 and 1993. In 1994, he joined the INT as an assistant professor, and became in 1998 an associate professor within the ARTEMIS Project Unit.

Since September 1995, he has been in charge of the Working Group on 'Dynamical Deformable Models' (GT4) within the CNRS Research Network on 'Information, Signal & ImageS' (ISIS). His research interests include mathematical morphology, differential geometry, PDE theory, physical modelling and multidimensional image processing, with emphasis on multi-scale representations and identification of deformable structures in dynamic images. Such mathematical and physical methods are applied within the framework of the sign language analysis.

M. Titus Zaharia

Titus Zaharia received an Engineer Degree in Electronics and the Masters Degree in Electronics from University Politehnica of Bucarest, Romania in 1995 and 1996, respectively. He is currently a PhD student at the ARTEMIS Project Unit. His research interests include new indexing techniques and object coding (meshes, 3D models). Considering an XML-like description language, he focuses on generic description schemes and descriptors for both still images and video squences. He contributes very actively to the emerging MPEG-7 standard by defining and evaluating motion and trajectory descriptors. The specific application concerns the automatic indexation of sign language video sequences.

M. Marius Malciu

Marius Malciu received the Engineer Diploma in Electronics from the Polytechnical Institute of Bucarest, Romania in 1996. He is currently a PhD student in the ARTEMIS Project Unit. His research is focused on 3D model matching in video sequences and on deformation modeling of 3D object. The targeted application concerns avatar face animation by estimating the 3D head pose and analysing facial expression from real, arbitrary and monoscopic 2D image sequences. He is a student member of the IEEE and SPIE societies.

M. Marius Preda

Marius Preda received an Engineer Degree in Electronics from Polytechnical Institute of Bucarest, Romania in 1998. He is currently a Ph.D. student at the ARTEMIS Project Unit. His research interests include 3D human body modeling and animation, object indexation and coding. His activities lie within the scope of MPEG-4-SNHC and MPEG-7 groups. Specifically, he contributed to the core experiments on virtual hand animation, hand BAPs (Body Animation Parameters) creation in the framework of sign language, and BAPs coding.

Instituut voor Doven, NL (IvD)

Organisational Profile

The Instituut voor Doven (IvD) is a publicly-funded institution for deaf children and adults, and for clients with multiple handicaps including deafness. IvD offers a full range of services including primary and secondary education, audiological care, psychological diagnosis and therapy, and social work. Its mission is the integration and emancipation of deaf people in society. It has pupils and clients throughout the Netherlands, and it provides services at distance as well as on campus. Moreover, it has important international functions in providing knowledge transfer to deaf schools in Eastern Europe and developing countries.

IvD has an active innovation policy, supported by an R&D department of approximately 30 staff members. The R&D department seeks to improve and update clinical and educational practices, and to enhance their effectiveness and efficiency through the introduction of new technologies, especially in telecommunication and computer-assisted learning. It participates in a number of European projects in the ACTS and Telematics Applications Programmes, as well as under the Educational Multimedia Taskforce. IvD is actively involved in the development, user testing and introduction of videotelephony, multimedia telecommunication and PC-based visual training and educational programs.

The R&D projects at IvD follow a practical user-centred approach, with end users and other stakeholders involved during all phases of a project. The results of these projects are used in IvD's own innovation processes as well as in support to other organizations. Examples are the introduction of PC-based videoconferencing in IvD's remote teaching and tuition services, the setting up of a telework centre for deaf people and the development of a multimedia CD-ROM for training both sign language perception and speech reading.

CV of Key Personnel: Dr. Ben A.G. Elsendoorn

1979-1982: Institute of Phonetics, University of Utrecht. Research on the production and perception of a Dutch foreign accent in English.
1982-1989: Institute for Perception Research (IPO), Eindhoven University of Technology. Research on speech synthesis based on diphone concatenation, and responsible for knowledge transfer and acquisition of external funding.
1989: Eindhoven University of Technology, co-ordinator of study information activities for future students.
1989-present: Instituut voor Doven (IvD), Dept. Research & Development. Senior researcher and project co-ordinator for research projects on multimedia applications in education and training, co-ordinator for EU-TIDE project DICTUM (1994-1996) and EU-EMM project EVIDENT (1998-). Participation in other national and international research projects and responsible for acquisition of external funding. Co-organiser of NATO-Advanced Research Workshop on Learning Technologies for the Deaf, Sint-Michielsgestel, June 1991.
1999: Invited lecturer on Interactive multimedia and education of the deaf, University of Patras, Greece.

Dr Han Frowein

Han Frowein received academic training in experimental psychology at the universities of Melbourne (Australia) and Utrecht (The Netherlands) and a PhD degree in 1981 from the University of Tilburg for work on human information processing. From 1979 to 1992 he was a social researcher and human factors consultant for the Netherlands PTT, collaborating on international projects and coordinating CCITT and ETSI standardization groups. In 1984-1985 he was awarded a Fogarty

Fellowship at the National Institutes of Health in Bethesda, MD, USA. Since 1992 he has worked for IvD on developing audio-visual telecommunication services for deaf people. During the Fourth Framework period he was responsible for the IvD contribution to the ACTS projects UMPTIDUMPTI and IBCoBN, the TIDE project IBIDEM and the TAP projects CANS, Periphera and Domitel.

Royal National Institute for Deaf People, UK (RNID)

Organisation Profile

The mission of the RNID is:

To be a powerful force for change with government, public and private sector organisations.
To change radically the attitudes and behaviour of individuals towards deaf and hard of hearing people.
To provide services directly to deaf and hard of hearing people to improve their everyday lives.
To be a catalyst for research in medicine and technology to improve the lives of people with a hearing loss.

The Royal National Institute for Deaf People is the largest charity representing the 8.7 million deaf and hard of hearing people in the UK. As a membership charity, it aims to achieve a radically better quality of life for deaf and hard of hearing people. It does this by:

Campaigning and lobbying to change laws and government policies.
Providing information and raising awareness of deafness, hearing loss and tinnitus.
Training courses and consultancy on deafness and disability.
Providing communication services including sign language interpreters.
Training interpreters, lip-speakers and speech-to-text operators.
Seeking lasting change in education for deaf children and young people.
Employment programmes to help deaf people into work.
Residential and community services for deaf people with special needs.
Providing Typetalk, the national telephone relay service for deaf and hard of hearing people.
Equipment and products for deaf and hard of hearing people.
Social, medical and technical research.

The RNID Library is the largest library in Europe on deafness and hearing loss. It has specialist publications ranging from academic journals to books for children.

Registered Charity No. 207720

CVs of Key Personnel: Mr Alex McIntosh

Alex McIntosh is Head of Trusts and Statutory Funding with the Royal National Institute for Deaf People and in 1998 was European Funding Manager. RNID increased its European activity in 1998, with over 10 projects including Sign Language Training and Transnational Technical Research work. Prior to this Alex worked with a non-profit Housing Association, devising and managing programmes to combat social exclusion- an INTEGRA network project with 7 other EU states, and a consortium of UK Local Authorities and NGOs. Alex qualified in 1969 as a Chartered Librarian and has worked in public service in 3 London Boroughs; directing arts, libraries, galleries, museums and tourism

Dr John Low

John Low is the Director of Technology with the Royal National Institute for Deaf People, responsible for supporting, promoting and disseminating technical and medical research into deafness and hearing loss. Particular emphasis is placed on producing tangible benefits for deaf and hard of hearing people from new and emerging technologies. He obtained a PhD from the University of Aberdeen in Bio-Medical Physics for work on speech dysfluency and auditory feedback before pursuing a commercial career. Areas of activity include through-water speech communications for saturation diving operations, remote telecommunications control methods and high-speed machine vision systems for industrial applications

The Post Office, UK (PO)

Organisational Profile

The UK Post Office was founded in the year1640, and now has some 200,000 employees. Turnover in 1997-98 was £6,759 million pounds. Today, there are four main businesses:

The Royal Mail:
This collects and delivers 72 million pieces of letter mail per day.

Post Office Counters Limited (POCL):
POCL has 19,000 retail outlets in the UK, and is the largest retailer in Europe. POCL also administer and dispense government benefits including social security, child benefit and pensions. POCL are the only outlet for TV licenses. POCL also provide a service for the payment of utility bills. POCL provides banking facilities and financial services. In addition to the above services and providing access to postal facilities and products, Post Offices also sell a large range of goods. In many small communities in the UK, The Post Office often provides the only shopping facility.

Parcelforce:
Parcelforce provides a parcel delivery service at a uniform UK tariff, handling approximately 4 million domestic and international items per day. Parcelforce now includes German Parcel.

Subscription Services Ltd (SSL):
SSL's main businesses are TV licensing for the BBC and customer management/tele-business services.

Profit before taxation 1997 -1998: £651 million

Expertise Relevant to the ViSiCAST Project:

- The 'engineering' of transaction discourse
- The design and engineering of systems for ease/acceptable use by both counter clerks and customers
- Making systems robust for a transaction environment
- The evaluation of systems to be used in a transaction environment

CVs of Key Personnel: Dr. Joanne Coy

Dr. Coy is currently the Research Manager, Post Office Research Group. She is responsible for introducing new technology to the organisation by research and external collaboration in the following areas in the areas of: image processing, assistive technologies, mechatronics and mechanical design.

She has a BSc (Hons) in Mechanical Engineering. Her doctorate studies were in Co-ordinate Metrology. Previously she was a Principal Engineer and technical Team leader at GKN Technology Ltd.