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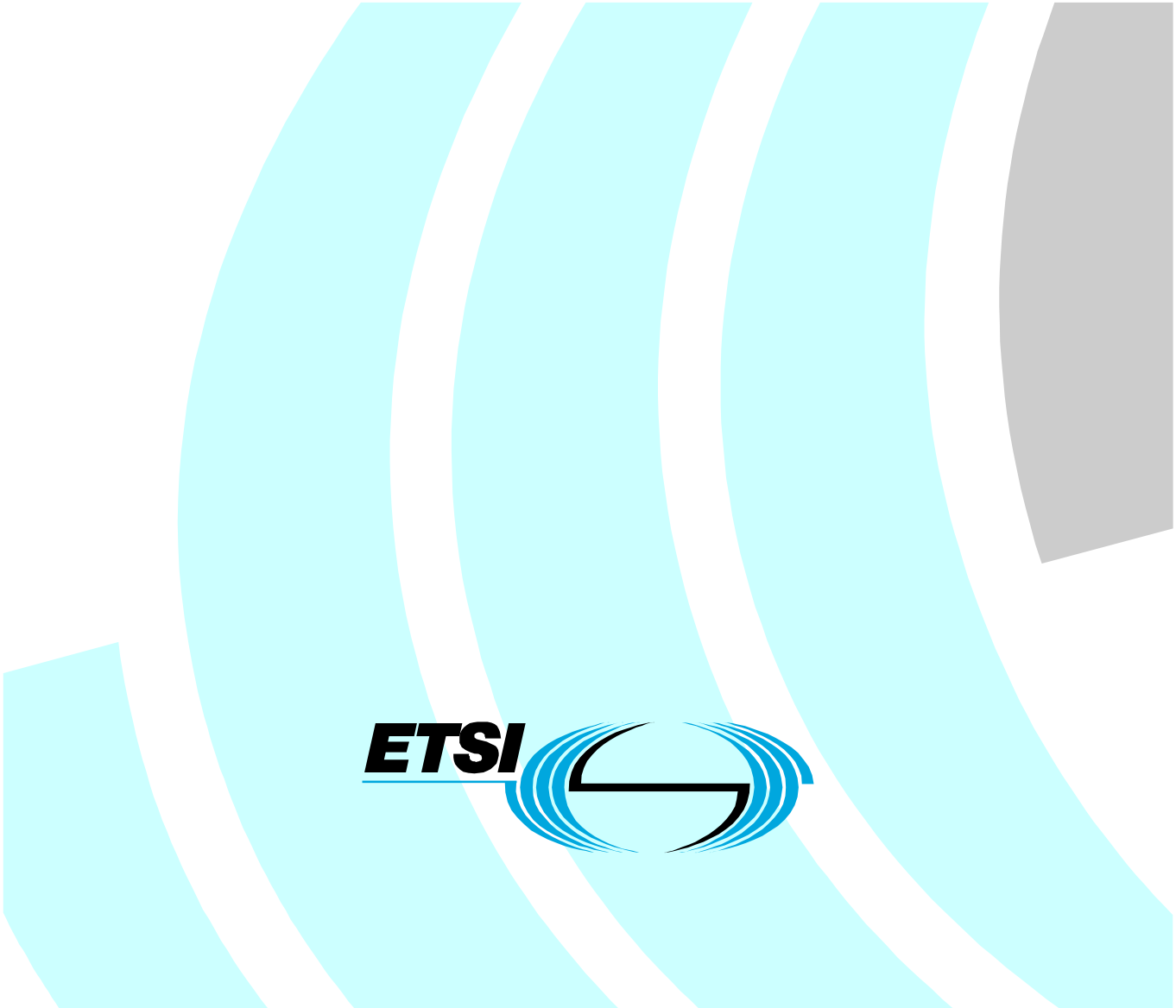
Technical Report

Human Factors (HF);
Two surveys on assistive technology



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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Human Factors (HF).

1 Scope

The present document records the details of two surveys made in connection with work TR 102 068 [1] on requirements for assistive technology devices in Information and Telecommunications Technology (ICT) systems.

No attempt is made to analyse the results which are given here solely for information and to provide possible input for other work.

2 References

For the purposes of this Technical Report (TR), the following reference applies:

[1] ETSI TR 102 068: "Human Factors (HF); Requirements for assistive technology devices in ICT".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Bluetooth: wireless technology enabling secure transmission of both voice and data

DAISY: international standard for talking books

design for all: design of products to be usable by all people, to the greatest extent possible, without the need for specialized adaption

e-book: an electronic book

NOTE: A electronic or paperless book in a digital form that can be read on the screen of a PC or other electronic device.

identity tag: data block used to give information on an MP3 audio recording

T-mode: telephony mode on a hearing aid, used to provide an input by inductive coupling rather than via a microphone

text prediction: procedure whereby text entry can be enhanced by predicting subsequent portions of the text by analysing the text already entered

textphone: terminal offering real time text conversation through telecommunications networks, as a stand alone unit, as an addition to a voice telephone or as an application in a multi-function computer based terminal

versabraille: machine, no longer manufactured, which featured a Braille display, a Braille keyboard and a serial interface port

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AT	Assistive Technology
ATM	Automatic Teller Machine
CCTV	Closed Circuit TeleVision
CD	Compact Disc
CP	Cerebral Palsy
DAISY	Digital Accessible Information SYstem
GPS	Global Positioning System
HCI	Human Computer Interface

HPC	Handheld Personal Computer
HTML	HyperText Markup Language
ICT	Information and Communications Technology
IDT	IDentity Tag
LCD	Liquid Crystal Display
MG	Myasthenia Gravis
MND	Motor Neurone Disease
MS	Multiple Sclerosis
OCR	Optical Character Recognition
OED	Oxford English Dictionary
PC	Personal Computer
TV	TeleVision
UMTS	Universal Mobile Telecommunications System
VI	Visually Impaired
VTS	Virtual Touch System
WWW	World Wide Web

4 Background

STF 181 was set up to produce TR 102 068 [1], a technical report intended to give guidance on the needs of elderly and disabled people for assistive technology devices and the requirements for the interconnection of such devices to ICT systems.

As part of the background research carried out at the commencement of the project, two questionnaires were sent out, one aimed at discovering the assistive technology needs of elderly and disabled people and the second to discover the views of the disability industry on the requirements for standardization.

The present document records the replies to those questionnaires so as to make them available to other researchers in the field of disability.

5 Questionnaire to disability professionals

5.1 The questionnaire

5.1.1 Contents

The questionnaire contained the following introduction:

Thank you for offering to answer this brief questionnaire on the future requirements for personal assistive technology for people with disabilities.

The aim of this questionnaire is to discover what elderly and disabled people will require from the assistive technology in the future. It refers to technology which is used to enable people to use current and future Information and Communication Technology (ICT) devices such as mobile telephones, computers and cash dispensers by using their personal assistive devices such as Braille or large character display or a sticky keyboard.

This work is being carried out for the European Telecommunications Standards Institute (ETSI). The results will be used to ensure that in the future, people with disabilities will be able to use the full range of information and communication technology.

In some situations and for some disabled people assistive technology will be met by design for all. For instance a telephone could have a text display so that somebody could use it who had a hearing impairment, but a deaf blind user would need a Braille display.

The aim of this questionnaire is to discover your views, please answer as many questions as you can and please also give me as many extra comments as you can.

Thank you very much.

It continued with the following questions:

1) Design for All or Assistive Technology?

   Please can you tell me in what circumstances would people in the following categories require assistive technology to use information and communication technologies? Please answer for all categories that you have knowledge of.

   1.1) People with physical disabilities (including people with reduced mobility dexterity, reach, balance, strength, stamina and height).

   1.2) People with sensory disabilities (including people with reduced vision, hearing or reduced vision and hearing).

   1.3) People with cognitive disabilities (including people with learning disabilities and mental health problems).

   1.4) People with communication disabilities (including people who are illiterate or who have speech impairment).

   1.5) People with multiple disabilities.

2) Type of Assistive Devices Required?

   What types of assistive technology do people in the following categories require? Please answer for all categories that you have knowledge of.

   2.1) People with physical disabilities.

   2.2) People with sensory disabilities.

   2.3) People with cognitive disabilities.

   2.4) People with communication disabilities.

   2.5) People with multiple disabilities.

3) What are the most important requirements for assistive technology (for instance weight, cost, portability, etc.) for people in the following categories? Please answer for all categories that you have knowledge of.

   3.1) People with physical disabilities.

   3.2) People with sensory disabilities.

   3.3) People with cognitive disabilities.

   3.4) People with communication disabilities.

   3.5) People with multiple disabilities.

4) What future developments in information and communication technologies will have particular relevance to people with disabilities?

5) Do you have any other comments on the future of assistive technology?

6) Can you tell me in your opinion at what degree of disability will a user have to use assistive technology rather than design for all?

7) Your details?

   Name:

   Organization:

   Town/City:

   Country:

Email:

Thank you very much for your time and contribution.

Would you like to receive a copy of the results from this research: Yes/No

If you know of anybody else who would be willing to answer these questions please tell me their name and contact details.

5.1.2 Comment on the questionnaire

As can be seen in clause 5.1.1, the questions asked were somewhat open-ended and the requested categorization by types of disability in the first three questions appeared to be treated differently by the various respondents. This is likely to make it a somewhat difficult to analyse the results. Nevertheless the replies contained a significant amount of useful information in the field of disability which it was thought worth preserving and making public for other workers in the field.

The full results of the survey of professionals working in the disability field are set out in annex A. The questionnaire was sent out to a list of 76 people and there were 35 respondents from 22 different countries. As can be seen from the replies, there were some different interpretations of the intent of the question structure, some users answering separately for each aspect of disability and some giving one answer that appeared to be intended to cover all aspects.

6 Questionnaire to disability equipment industry

6.1 The questionnaire

6.1.1 Contents

Many Information and Communication Technology (ICT) industries are working on making their products usable by disabled and elderly users. When inclusive design does not meet all the users' needs, it will be necessary to use assistive devices. Currently there is little standardization of the interface between assistive devices and ICT systems.

1 In your opinion, would it be useful for there to be standard interfaces between assistive devices and ICT systems?

2 What features should be covered by such a standard?

3 Should the standard protocols be independent of the transmission system (e.g. infra-red, Bluetooth, hard wire connection)?

4 What other aspects should be considered when preparing this standard?

I look forward to hearing from you.

6.1.2 Comment on the questionnaire

The question in clause 6.1.1 was open-ended and so the replies do not lead themselves to simple analysis. On the other hand they were simple and straightforward and produced valuable answers in a reasonably logical form making the information contained accessible to the user.

There were 49 respondents from 10 different countries. Of these, 35 provided answers to the questions in the survey. These replies are set out in annex B.

Annex A:
Answers to questionnaire to disability professionals

A.1 Answers

1) Design for All or Assistive Technology?

Please can you tell me in what circumstances would people in the following categories require assistive technology to use information and communication technologies? Please answer for all categories that you have knowledge of.

1.1) People with physical disabilities (including people with reduced mobility dexterity, reach, balance, strength, stamina and height).

1	Yes.
2	For example when the different machines are installed too high or when touchscreens are used.
3	Use of keyboards and pointing devices. Manipulation of memory supports (e.g. Floppy disks and CD).
4	Yes.
5	Assuming that they have no problem with seeing and hearing then many applications can be envisaged which give the users control of the IT devices other than the normal keyboard. These would include: speech synthesis and speech output, remote switching using any part of the body over which they have control (e.g. foot and chin switches, to drive menu selection for commands and letters) possum-type controls using breath, large keyboards and other large manual switching, eye switches, etc. All of these can be used to control the environment of the handicapped person and to operate forms of transport. These are all part of obtaining and disseminating information. One can assume that for most of this group the form of the information media does not have to be changed, the technology is required to enable the reader to get to and to control the information.
6	Sorry, I am not an expert. Reduced mobility may be in some fields important to have assistive technology for visually impaired and blind people.
7	*No answer*
8	*No answer*
9	Back or neck injury, stroke, Bone cancer and nervous system disorders such as MS, MND, MG, and CP.
10	Where there is a lack of an accessible and easy-to-use keyboard.
11	*No answer*
12	*No answer*
13	From my experience, a large number of circumstances in dealing with daily living could be made much easier and less complicated for people with physical disabilities. However, it is true that many of the items that are available, such as Bank withdrawal machines, are inaccessible and therefore these need to be made accessible to all.
14	All would depend on the type and extent of disability.
15	If possible, of course, design for all is to prefer and this ought to be the leading principle.
16	People with severe physical impairment have to use assistive technology to use computer. Design for all can not be an adapted response in many cases. - Design for all could be applied for mobile phone, for at least have an access to the fundamental use of phones.

17	They have to use lifting devices (distrophic), and devices that are not out-of-reach (but those are not assistive tech devices, just have "assistive" placement).
18	Telemedicine Information on AT solutions Information about local environment (e.g. in a street: where is the nearest toilet?)
19	Examples include - difficulty holding telephone handsets, difficulty using keypads or keyboards especially if the keys are small or the keypad is complex, difficulty opening doors of phone booths, difficulty using equipment placed too high up, difficulty using phone booths with limited room for access or too small in dimensions, difficulty using standard computer keyboards because of layout/slope/etc., difficulty in controlling computer mice.
20	*No answer*
21	*No answer*
22	Using the computer; operating devices in the home; Note-taking at meetings
23	*No answer*
24	The visually impaired require assistive technology in all those cases where a product is not designed in a way that makes it possible to use it at all or use certain function without using sight - e.g. product with a display like a mobile phone or a regular phone, personal digital assistant (there are several especially designed for blind and partially sighted) and the classical; the computer. It is necessary that you think of assistive technology in a broader sense. Today you have things like screen readers, speech synthesisers and enlargement programs and still there are many programs and webpages that are inaccessible because they use the wrong coding, etc. Therefore, assistive technology is important, but it is important to think "Design for All" and not just think that you can solve everything with assistive technology. It is also important is this connection to think of design and a thing like buttons - you have to be able to operate the both the regular and any assistive device. Her you should consider tactile information and the use of colours. It is no use that a product speaks if you have to find a certain button to make it speak - and you cannot find that button. It is, therefore, also a very good idea to have speech controlled devices - e.g. a regular phone where you can dial via speech control, a mobile phone. It is preferred that a product is universally designed from the beginning, since that will always be the best solution - that you, for instance, built-in speech in all devices with a display and build in a screen reader, a speech synthesis and an enlargement program in computer software like Windows. This will mean that blind and partially sighted will have access to the same things as sighted persons (not having to depend on whether there is a assistive device or not), they will also always have the same/the newest version available and the will not have to carry or depend on assistive technology for their technology to work.
25	This category will mostly use usual (not special) means of ICT.
26	*No answer*
27	*No answer*
28	Yes, specialized keyboards, special workplace settings.
29	Reduced dexterity might mean people need an assistive device to help input commands or data into a computer that they have to use at home or work. For public devices care must be taken over the siting so that people in wheelchairs or very small people can still read the screen and use the keypad.
30	For reading books, magazines and other information
31	Visually handicapped people need ICT or should use ICT in the same extend as sighted people. Assistive technology is needed mainly to enable to control ICT devices and to transform output information to accessible formats if those features have not yet been included in the standard ICT systems. Direct use of assistive devices is important, in particular, when the communication between the man and ICT device can have a form of text information or graphical information which could be more or less automatically transformed to brief, but full meaning text information. When the nature of communication is really graphical, the assistive technology should be combined with or replaced by a service like commented video. In any cases when accessibility could be ensured by design for all that way should be preferred
32	In daily living, employment, leisure and education.
33	Public telephones and information pillars should be placed and equipped in a way they can be accessed.
34	The Assistive Technologies must promote inclusion of disabled people in modern information society on the base of their individual needs and also their striving for mastering needed skills and achieving success in life.
35	When using bank terminals, cash dispensers, various card readers and terminals (e.g. petrol station) and public facilities (e.g. kiosk). When accessing internet, e-mail -When using a mobile phone. I think these points apply for all categories below, but the offered solution will be different.

1.2) People with sensory disabilities (including people with reduced vision, hearing or reduced vision and hearing).

1	Yes.
2	When touch screens are used or when information is only give visually or by speech.
3	Use of direct manipulation techniques (e.g. pointing devices). Access to visual information on the screen (enlargement for people with reduced vision and screen readers for blind people). Non-solved problems for access to graphics and pictures. Access of the audio component of multimedia information (hearing impaired) In telecommunications, hearing disabled people need support to access the telephone. The telephone is completely inaccessible for severely disabled users. The telephone channel can be used to transmit text information.
4	*No answer*
5	Visually and auditorially handicapped people require to use the technologies to transpose information into a form other than the one that they cannot read. In simple terms deaf people require audio information to be translated into sign language and/or subtitles. Visually impaired people require textual information to be translated into larger type, audio or Braille. Information such as tables, formulae, diagrams, pictures etc. pose particular problems for visually impaired people and to-date require human intervention to transpose them into an accessible form. IT can therefore be used in almost all situations, from private study at home to access to libraries. Increasingly the technologies are enabling people with sensory handicaps to access the Internet and other information forms. It has not yet become sufficiently widely integrated into society to enable blind and visually impaired people to use ubiquitous items such as Bank ATMs, ticket machines at stations, etc. There are few special situations, such as some libraries in which the user can find adapted terminals. Deaf and hard of hearing people have similar an equally important needs for all devices which depend upon sound. They need voice to text systems for many forms of telephony. Increasingly companies are using menu driven voice systems for client services.
6	In short: in all fields, in which information is presented exclusively optical: Displays, keys to press, information in elevators in governmental buildings.
7	People with sensory disabilities require assistive technologies to use ICT in the following circumstances - reading activities - communication activities, including watching TV - mobility in the public environment, including participation in public events - integration at the work place - leisure activities.
8	To use a computer, to access information that is digital. Braille bar, speech output, enlargement software, etc. For mobility. For work, etc.
9	Hearing sight impaired, vision loss, stroke, diabetes.
10	Where there is a lack of captioning for audio, where tables frames are poorly marked, where there is a lack of keyboard support or screen reader.
11	People with reduced vision and blind people require assistive technology in their working life, they need special computers, phones and faxes for example. They also need stairs, which are marked prominently, that they can see where they are going and on written documents they need big, fat letters and contrasts in colours (black letters on a yellow background for example).
12	*No answer*
13	Very similar to the answer earlier, however, the print on many of the machines is quite small and, therefore, inappropriate for those who have some height. Also, when it is sunny it can be difficult, because of glare, to use some of the machines.
14	No experience.
15	Visual impaired people need some devices for reading the displays either through magnification, speech or Braille. I think that in most cases this can be arranged through "Design for All" (at least magnification and speech).
16	People with hearing impairment needing the T-mode have no access to mobile phones; those are generally not compatible. Exception for NOKIA (and other brands?) which have an accessory. People with reduced vision can use mobile phones, but partially. Many functions need to be able to read the very small screen. The access to all functions should be possible only with assistive technology. Use of computers for blind people requires an assistive technology.
17	Blind people use all sorts of assistive devices. All the devices out there that have mainly visual input/output need to have extension for blind users. Deaf people need to use devices with visual, and not audio output. Deaf-blind need to use Braille displays, and other devices with tactile output. Circumstance is everyday living, learning, any touch with existing technology, not adapted for any of these categories means circumstance to use assistive technology (I did not quite get the point of this question. It is clear that I stated the obvious in my answers, but that was due to the unclear point of the question.)
18	Intelligent hearing aids/orientation devices to pick up information about environment.

19	Examples include: difficulty using non-standard keypads and keyboards where it is impossible to distinguish which key is which, difficulty understanding voice messages where the volume is too low, the speed of utterance too fast or the speech is unclear, difficulty using any service dependent on voice responses if the user has no hearing, difficulty using displays where the text is too small, uses inappropriate typefaces, colours or background, difficulties using any service or equipment dependent on visual displays if the user has no sight, a combination of all the above if the user has no useful sight or hearing.
20	*No answer*
21	I can answer only for the group of blind and visually impaired people and I delete all other questions for a better overview, starting with Question 2).
22	Meetings; work; social communications; computers; reading books; managing any digitized domestic appliances; Mobile phones; Access to the Internet; Banking; Living.
23	*No answer*
24	*No answer*
25	I know only one possible answer for all the categories: they will use it if they 1. have it (which is not always the case) 2. are trained to use it 3. can not get information or communicate with usual means of getting information or usual means for communication. Not only every category of disability, but every individual will have different response to the situation in which he will try to be as independent as possible. This category will very often have to use Assistive Technology.
26	People with visual impairments would use the assistive technology when the "design for all" would not be sufficient, depending on their functional vision, their orientation and other skills. A blind person would be able to use a cash dispenser if all the dispensers would be designed in the same manner with constant buttons which match the text on the screen.
27	More or less all situations. Denmark - and the rest of the world - are turning into a networks community. That means that state and government puts a lot of information online and that more and more paperwork between citizens and local government is handled via the Internet. So this group need assistive technology in every way when it comes to the net. Television is another major thing for assistive technology. We do not have an effective system to interpret direct shows like political debates or the like. A big thing is also mobile telephones. We are more or less cut off from influence on 3rd generation and we need to begin working toward influence on 4th generation mobile phone, net and the future services here. And then, of course, a lot of information systems in daily life. A lot of this goes for the other group also.
28	Yes, special equipment and software is needed to perform input and output operations that are standard for other users.
29	People with visual impairments need alternative output devices e.g. large display size or speech output. They might need some indication on a keypad of how to find keys e.g. the dot on the 5 of a number pad. Some standardization of which way up the keypad is would also help or a dot on the 1 and the 5 to show whether the keypad was like a phone or a number pad on the computer. For people with reduced vision and hearing the possibility of using amplification could be considered although for public devices security may be an issue with speech output. Some deaf blind people can read Braille so soft-Braille output is a possibility although weatherproofing might be an issue for public machines. For machines at home then speech output, soft Braille output, headphones with amplification and magnification programs are all options.
30	*No answer*
31	*No answer*
32	In daily living, employment, leisure and education.
33	Information transfer should be presented in audible and visual alternatives. Touch screens are inappropriate for visually impaired. Buttons have to be marked with tactile symbols.
34	*No answer*
35	*No answer*

1.3) People with cognitive disabilities (including people with learning disabilities and mental health problems).

1	*No answer*
2	When the information that is gives is to complex.
3	Very little support is available for cognitive disabilities. Some simple computer based communication systems are available.
4	*No answer*
5	People with learning disabilities and mental health problems often require personalized help and as the handicaps increase the need for trained human intermediary's increases. In certain cases it is known that formats created for one group may help another. For example many of the developed countries are finding that dyslexics outnumber the visually impaired as users of audio-books. For such people text-to-speech technologies in its various forms are proving useful. In addition the ability to alter colours and text formats on screen can provide assistance to many with learning difficulties.
6	Information as simple as possible, fuzzy logic to find out, what the user really wants.
7	*No answer*
8	*No answer*
9	Left side strokes, CP.
10	When navigation is poor, when screen design is confusing and complex, when targeted icons are not used.
11	*No answer*
12	Most people with intellectual disabilities have great difficulties in accessing information, be it for their day-to-day life or to just try to keep up to date with the news that may concern them. I have participated to a symposium defining what the concept of "accessibility" means for these people. This entails a lot of problems in education, on the workplace, in the city, during leisure time, it can aggravate the disability through lack of early and continuous learning. It is also a strong difficulty for self advocacy.
13	These are probably some of the most difficult group to deal with, as the language to be used must be simple and understandable. Also it is difficult for many to remember access numbers and I would love to see someone attempting to overcome these obstacles.
14	No experience.
15	*No answer*
16	*No answer*
17	There are lots of new computing devices for the people with cognitive disorders. Mainly for kids: Simple picturebooks, with sounds and lots of colours. That way many sensors are excitated, and some things can be perceived out of the everyday context. That way is easier to extract important from unimportant information, and the redundancy is reduced. That is a great step in education of mentally disabled.
18	Talking with friends and carers in appropriate "language" (e.g. symbols). Text/symbol mobile phones for remote care.
19	Examples include - difficulty using complex instructions or text written in technical language, difficulty using services that depend on reaction to voice or text prompts within a set period of time.
20	*No answer*
21	*No answer*
22	No experience.
23	*No answer*
24	*No answer*
25	In my opinion this category will rarely use special equipment.
26	*No answer*
27	*No answer*
28	Yes, computers do not get tired and can cope with repetitive tasks.
29	Some things that would help might be within the interface rather than add on technology e.g. a simplified user interface or an interface with icons as well as or instead of text. A different keyboard with icons or larger letters might help. Things like sticky keys in Windows are useful.
30	*No answer*
31	*No answer*
32	Access to information and reduction of stress.
33	No experience.
34	*No answer*
35	*No answer*

1.4) People with communication disabilities (including people who are Illiterate or who have a speech impairment)

1	Yes
2	When symbols are not used.
3	Illiterate people need support with text information and communication systems (Synthetic speech can be useful in some situations). Speech impaired people need support in using interpersonal communication, Text-based systems and speech synthesis can be useful.
4	Yes!
5	Illiterate people may benefit from text to speech facilities if available at public terminals as well as private terminals/computers at home/office etc. Given the increasing use of icons and the low cost of speech output a non-reader could still navigate and achieve access to information.
6	Information in as many kinds and formats as possible.
7	*No answer*
8	*No answer*
9	CP, MND, right side strokes.
10	When no clear speech output or simple icon based output is available.
11	*No answer*
12	Many people with intellectual disabilities do experience communication difficulties, be it expressive or receptive communication. This is particularly the case of people with autism, where not only language but non verbal communication is impaired.
13	For many the answer earlier is also relevant here, but the difficult could come in machines which pick up from voice recognition. However, I am certain that with some research, this can be overcome.
14	No experience.
15	*No answer*
16	*No answer*
17	I do not believe in this category as a disability category. Illiterate, and speech-impaired people are not mentally disabled, but they are often perceived in that way. This is wrong attitude toward them, and unjust. I think they can use common technology, and specialize in use of some kind of communication and not another. The problem is in schooling system, and not in disability of those people.
18	As earlier, Live "Interpretation" of broadcasts.
19	Examples include - difficulty using services that require the user to respond with clear speech, difficulty using services that require the user to read and understand written instructions or text displays.
20	*No answer*
21	*No answer*
22	People with dyslexia benefit from voice activated computer-based word processing; spell-checking Speech impairments can be substituted by computerized speech output systems; pointing devices; The situations would include letter-writing; telephony; conversing directly with another person; expressing hunger; need for assistance.
23	*No answer*
24	*No answer*
25	In my opinion this category will rarely use special equipment.
26	*No answer*
27	*No answer*
28	Yes, via Bliss communication, high resolution video telephony, etc.
29	Not really my field but speech output for people with a speech impairment would help them communicate with other people. There is equipment that uses prediction so when a person starts to type a word it gives them a range of options for the word then they can choose the one they want, also the ability to store phrases that can be spoken on a keystroke. Voice recognition would be useful for people who are illiterate as well as speech output.
30	*No answer*
31	*No answer*
32	Literacy can be overcome through good education, assistive technology can help people with speech impairments.
33	Allow written communication in public communication systems: installation of keyboards, stored phrases in synthetic or digitized voice.
34	*No answer*
35	*No answer*

1.5) People with multiple disabilities.

1	Yes.
2	See my answers to the points earlier.
3	Unfortunately this is a sector not very developed.
4	Yes.
5	This would be a combination of some of the earlier comments. What is clear from that last 2 years of IT solutions for handicapped people is that designs are developed to assist a specific handicapped person. It is then sometimes possible to generalize an application.
6	Combination of what I said earlier.
7	*No answer*
8	*No answer*
9	All or many of the above.
10	Synthesis all above
11	*No answer*
12	*No answer*
13	The answers to all of the above come into the equation here. However, it should also be recognized that this is the group who are most likely to have an aide or assistant continuously with them and therefore research into this particular group should be undertaken to ascertain whether or not they are ready to have the assistant or aide help them.
14	See 1.
15	*No answer*
16	*No answer*
17	This category is too broad to speculate about the wide range of devices those people could use. There is often approach in design of a device for an individual, and not for the entire category. And I like that particular approach: "Make device for one's persons needs," especially regarding persons with multiple disabilities.
18	Adapted physical support and information interface to standard commercial communication devices.
19	A combination of any or all of the difficulties above depending on the nature of the multiple disability. The problem is that some may cancel others out with a single disability, but with a multiple disability this is not the case. For instance, a blind person can be helped by replacing visual instructions by spoken instructions, and a profoundly deaf person can be helped by doing the opposite, but neither approach will resolve the difficulties of a person who is both deaf and blind.
20	Public passenger transport - Use of public services as libraries, university, schools - PC, computer systems - World Wide Web - literature procurement - Aids for daily life.
21	*No answer*
22	Communicating with others; accessing the computer; moving about.
23	If possible any machine should be designed and built in a way that it may be used by as many different persons as possible. So the needs of persons with disabilities should be taken into account from the very start. People with reduced vision need acoustic signals, or if necessary, voice response as feedback when using a machine.
24	*No answer*
25	In my *opinion* this category will rarely use special equipment.
26	*No answer*
27	*No answer*
28	Yes, but more attention has to be paid to the compatibility of their assisitive equipment.
29	Also the input needs to cater for different problems.
30	*No answer*
31	*No answer*
32	In daily; living, employment, leisure and education, including some degree of independence.
33	The sum of above.
34	*No answer*
35	*No answer*

2) Type of Assistive Devices Required? What types of assistive technology do people in the following categories require? Please answer for all categories that you have knowledge of.

2.1) People with physical disabilities.

1	AT necessary, e.g. sticky keys, larger keys that are clearly separated.
2	Machines that are in reach. Speech recognition.
3	Special keyboards and mouse emulators. Supports for the manipulation of objects. Public terminal adaptations to make them accessible when using a wheelchair. Scanning techniques. Text prediction.
4	Yes?
5	*No answer*
6	May be speech input or usage of a device via the mobile phone.
7	*No answer*
8	*No answer*
9	Use of handset, head set, putting it on adjusting it, dialling out, Ideally decent voice controlled telephone including dialling and hands free capability (which actually works). Mobile or walkabout telephone to carry in your chair with hands free dialling and speech is also required.
10	Alternative methods of input.
11	*No answer*
12	*No answer*
13	These can vary depending on the severity of the impairment, the educational levels achieved, the accessibility of the environment, etc. This answer is for all types and unfortunately the vast majority of assistive technology that will be required is down to the individual and their interaction with the environment and with society.
14	This can include technology to work the computer, to write, to make reading more accessible.
15	*No answer*
16	Many solution exists, up to system which can be used with just one eye, with virtual keyboard on the screen.
17	General notice to this question is: "Majority of people never require something unless it is already there". Example: no blind person required a PC with a speech synthesizer in the 1930, but they were as blind as today's blind people. Market defines needs. That is why I will answer to this question describing my knowledge of the existing devices for the deaf, blind, etc. Various lifting devices (cranes), mobile devices with reduced weight. Switches, and large keys. Special input devices, keyboards, speech recognition.
18	Reliable, cheap, desirable (applies to all below)
19	Difficulty holding telephone handsets - provide hands free equipment, such as loudspeaker phones, neck loop microphones, or provide shoulder rest so that handset does not have to be held continuously. Difficulty using keypads or keyboards especially if the keys are small or the keypad is complex - provide customized keyboards, i.e. sticky keys to allow easier key presses, provide additional plug-in keyboards with larger keys, provide chatboards for mobile phones to allow plugging in full qwerty keyboard to replace mobile phone keys, provide colour coded keyboards to make them easier to understand. Difficulty opening doors of phone booths - provide doors that require less force to open, provide automatic doors, provide phone booths without doors (though this may lead to privacy problems). Difficulty using equipment placed too high up - relocate or redesign the equipment or provide ancillary equipment at a lower level for, e.g. wheelchair users or people with restricted growth. Difficulty using phone booths with limited room for access or too small in dimensions - build them bigger and better! It might be possible to provide ancillary equipment on the outside of the booth, but that would reduce privacy unacceptably. This is something that assistive technology cannot really solve. Difficulty using standard computer keyboards because of layout/slope/etc. provide ergonomic keyboards, sloped, ones that split into two halves, ones with alternative layouts or without number keys, etc, use speech recognition software to remove the need to use the keyboard at all. Difficulty in controlling computer mice - provide alternative form of mice, either by key presses instead of mouse movements, or by alternative forms of mice, e.g. those worked by moving a bead across a rail which are available from specialist outlets.
20	*No answer*
21	*No answer*
22	Voice activated computers; Electric wheelchairs; voice activated devices in the home.
23	Cash dispensers and other machines for monetary transactions should be built in a way that persons with disabilities may use them.
24	The visually impaired need screen readers, speech synthesisers, enlargement programs, speech recognition systems/software, devices for reading displays and GPS-systems that have speech output and can be hand held. Ideally one device that does more than on thing. As you see earlier people with visual impairment often have to carry more than one assistive device in order to get around.
25	Specially adapted mobile phones, special computers, wheel chairs.
26	*No answer*
27	*No answer*
28	Permit me to refer to ISO 9999 for the broad categories.
29	*No answer*

30	People that are unable to hold a book or use a key board would need devices in order to manage a computer. Blind people would need Braille bars and speech synthesisers.
31	There are needed assistive devices enabling access to visual information issued by ICT and needed to its control. In particular, assistive devices should help to localize ICT terminals and/or to ensure connection with them, to control them and to input user information and to read visual information issued by them.
32	Automatic doors, etc. adapted computers, smart card facilities at home to assist in daily living.
33	Alternatives to commonly used command and control devices: one hand keyboards, mouth, eye or voice control.
34	The following below assistive devices required for visually impaired people: - Braille displays - speech synthesizers - screen reading software - electronic reading devices - closed circuit televisions - screen magnification software - computer controlled Braille embossers - devices for embossed graphics - personal electronic mobility devices - Web browsers for non-visual output - VirTouch Mouse for the blind, as part of a complete product integrating hardware, software and a pioneering methodology, all called the Virtual Touch System (VTS)
35	Alternative input device for people with no or limited hand function (one button control with scanning, alternative keyboard, speech recognition, foot-, head- or mouthswitches for control) or with bad mobility control (keyboard with bigger keys, one button control with scanning) - Headset and mic for mobile telephony with one of the above options for dialling and control, For PC use, alternative pointing device (to replace mouse) and options mentioned earlier.

2.2) People with sensory disabilities.

1	AT necessary, voice output and/or high contrast and large font sizes for vision impairments, Braille output for deaf-blind users.
2	Information that is visual and by speech. No touchscreen.
3	Transduction technologies (e.g. text to speech and speech to text). Amplification. Hearing aids.
4	*No answer*
5	Computers with speech output and Braille bars Screens which can be adapted (automatically with a code, a card or a proximity card) to the optimum conditions for the user. Text-to-speech and speech-to-text software and devices (such as adapted telephones for the deaf) Portable Braille and text to speech input devices. Cheap playback equipment for digital books, preferably ones that are searchable in the DAISY system or similar.
6	Output with speech and or Braille and/or large print. Input with feedback (acoustic, Braille, large print, input by connection with another device, e.g. mobile phone, Braille device, Speech input system.
7	Type of assistive devices required - auditory interfaces with ICT - special large letter keyboards with contrasting design - optoelectronic reading and mobility devices - special tools for access to the internet, in particular scream readers, speaking browsers and special website design.
8	Braille terminal, speech output (software), enlargement software.
9	For visually impairment The ability to control the phone by Speech control, big button raised bump - buttons with Braille. High contrast colour scheme for buttons, numbers. Option to give Confirmation of the number dialled by reading it back before dialling. The ability to say to your phone for instance "wake up telephone" 11 call Peter" and it then dials Peter. On programming - setting up the phone VIP find a double beep at the end of the menu so that they know where they are when selecting edit, delete. - For hearing impairment Text facility or the ability to connect a text phone (like available with old BT public telephones) or connect to a computer via a usb lead to the phone for visual feedback, an LCD visual feedback to show the number to be dialled.
10	Audio output, captioning, alternative lieg???
11	Braille-Computers and special machines for Reading (BildschirmlesegerAte). When the EURO is coming visually handicapped people will need a pocket-counter, which is able to transfer Schilling into Euro and vice versa. Special traffic lights must become a standard.
12	*No answer*
13	Same answer as 2.1.
14	*No answer*
15	For Braille readers a portable Braille display which is easy to connect to the ICT is desirable.
16	People with hearing impairment. - Induction loop for phones, and all information and communication sets (TV, multimedia terminal) - Alternative media (subtitle, written information).
17	Blind: Talking clocks, scales, colour indicators, light sensors, liquid sensors, and other kind of talking devices. Computer speech synthesis, Braille output devices, and writing machines. Other personal speech, and Braille devices. Deaf: Special light systems for door-bells, telephones and other devices with sound output. Child-cry sensors, and other noise sensors. TV titling devices, and speech recognition devices. Deaf-Blind: Vibrating clocks, Braille clocks, writing machines, and Braille displays. Other vibrating computer hardware.
18	Reliable, cheap, desirable (applies to all below).
19	Difficulty using non-standard keypads and keyboards where it is impossible to distinguish which key is which - provide raised edge on central key of keypad (usually 5) for easy location, ensure standard layout of keypads, e.g. numbers always go left to right, not down from top, provide large keys, provide Braille on keys, use speech recognition software to eliminate use of keyboard. Difficulty understanding voice messages where the volume is too low, the speed of utterance too fast or the speech is unclear - this is increasingly important with the growth of call centres and Automated Voice Response (AVR) systems. Encourage the development of standards for clear speech and lower speeds, fit inductive couplers for hard of hearing users, use volume control on handsets. Difficulty using any service dependent on voice responses if the user has no hearing -use textphones, use relay service (Typetalk), provide visual display equivalent of voice messages. Difficulty using displays where the text is too small, uses inappropriate typefaces, colours or background - use software to increase size of text and/or change colour and/or typeface of text, background or both, use speech recognition, use Braille terminals, use large print displays, encourage use of sans serif typefaces such as Tiresias. Difficulties using any service or equipment dependent on visual displays if the user has no sight - use audio/voice prompts instead of visual displays, use Braille terminals. A combination of all the above if the user has no useful sight or hearing - use special Braille terminals, such as VersaBraille (a replacement for these is urgently required).
20	*No answer*

21	Public transport: Visually Impaired (VI) people need large print Blind (B) people need tactile printed information and audible information for things that can not be reached as well as tactile floor indicators Banking/ITM: VI: displays with high contrast and large print. B: acoustic signals and speech output. PC: VI: Screen magnification, Screen readers to change colours and font sizes. B: Screen readers with Braille displays and/or speech output. Information systems in public areas: VI: High contrast and large print; the position of the information must be very close to the reader. B: Important information should be given by acoustic speech output automatically and also on demand. WWW: VI + B: All sites should be designed for the use of screen reader s (ADA) so that these people can use all the services (e.g. digit al libraries, time tables, ordering, newspapers. Aids for daily life: VI: Large displays with high contrast and large print on all objects of daily life. B: Tactile descriptions, where it is possible and speech output f or menus and displays.
22	Screen Reading software; scanning equipment and software; portable computers Visual Impairments: (notebooks, Braille note-takers); tape recorders (desktop and micro recording devices, i.e. Dictaphones); Guide canes; GPS devices for way-finding; Telephones. Hearing Impairments: Mini-com telephones.
23	Braille lines for using computers. Household appliances (washing machines, dishwashers, etc.) which give acoustic signals as a confirmation after a key has been pressed. If there are several keys and you have to select one, a voice response would be a very welcome feedback.
24	*No answer*
25	Specially *adapted mobile* phones, special computers, reading machines.
26	People who are extremely partially sighted would require large displays, or stronger contrasts, some might have to use a speech synthesiser, which would change the written messages on the screen into spoken ones. The same is true for some blind people. They might also need a Braille display, to be able to read the messages on the screen.
27	Enlargement programs, Braille devices, speech, specially designed user interfaces. AND, and I do know this is not a technology thing, but teaching. A comment to designed user interfaces: A lot of people cannot interact with the computer because of lack of understanding of the interface. But if you can build a system which allows individual interfaces, a lot of problems are solved. We are working on this project in Denmark now and I foresee a system solving a lot of problems.
28	*No answer*
29	VI people, a way of writing to people (in a work context passing on messages, emailing etc. in a personal context sending emails). A way of getting access to information such as books, information from the internet - anything really, what is on in the area, for research. Anything any one else would want from the Internet.
30	People with reduced vision that can not read printed text efficiently would need a digital talking book player, enlargement devices for their computer, CCTV, etc.
31	*No answer*
32	Sound sensors for location, adapted computers for reading and writing.
33	Tools for captioning and automatic speech to text translation for hearing disabled; text to speech conversion for visually disabled; speech output as alternative to screen output.
34	*No answer*
35	For blind people: Feedback by voice on the required actions (cash dispensers) or chosen options (e.g. dialling a phone number) Feedback by voice before actually performing the desired task (double-check that no mistakes were made in typing/input) Voice recognition for performing actions + feedback by voice - Voice synthesizer reading the info aloud, Braille display (hard to achieve). For deaf people: - Display showing all audio-messages when interacting with the device. - Alternative (keyboard) input for voice interactions. For deaf/blind: Braille display (hard to achieve but necessary) both for showing audio-messages when interacting with the device as for feedback on the required action or chosen options before execution.

2.3) People with cognitive disabilities

1	*No answer*
2	The use of short and easy to understand information. And information by speech. The use of symbols.
3	This is mainly a problem of simplifications of the interfaces and the services themselves.
4	*No answer*
5	*No answer*
6	Sorry!
7	*No answer*
8	*No answer*
9	The ability to fit shape and colour buttons over the standard buttons. other than this I have not much experience in this area.
10	Use of icons and speech output – simplified input and interactive devices.
11	*No answer*
12	Assistive technology can provide an additional learning environment which will be highly personalized and hence adapted to the learning capabilities of the child and later on the adult.
13	Same answer as 2.1.
14	*No answer*
15	*No answer*
16	*No answer*
17	Special educational computer software, and communication software.
18	Reliable, cheap, desirable (applies to all below).
19	Difficulty using complex instructions or text written in technical language - promote the use of simple, standard English, use visual and/or audio means where possible, i.e. graphics, illustrations, videos, tapes Difficulty using services that depend on reaction to voice or text prompts within a set period of time - increase time limits or allow options to do so.
20	*No answer*
21	*No answer*
22	No experience
23	*No answer*
24	*No answer*
25	Specially adapted mobile phones, special computers, reading machines.
26	*No answer*
27	*No answer*
28	*No answer*
29	*No answer*
30	People with cognitive disabilities might need DAISY multimedia in order to read. Which means they would need a computer and DAISY software, or just a speech synthesizer so that they can hear the text.
31	*No answer*
32	Hand held communicators with speech output for people with speech impairments.
33	No experience.
34	*No answer*
35	Simplified interface for interaction with any ICT device (adapted browser with limited choices, confirmation of actions before execution, pictograms) - Alternative keyboard (pictogram, Bliss symbols.)

2.4) People with communication disabilities.

1	AT necessary, voice output for illiteracy cases.
2	See answers to 2.3.
3	Mainly transduction technologies.
4	Yes.
5	*No answer*
6	Of course communication aids, but I am not an expert!
7	*No answer*
8	*No answer*
9	The ability to connect to a computer, handheld HPC, which has software to enable enhance speech and enhance sound.
10	Handheld speech output devices including those using symbols as icons
11	*No answer*
12	ICT can provide quite a lot of assistive technology to compensate this communication difficulty. To a certain extent, it is using similar material as for people who have some motor impairments such as cerebral palsy: for example, they can use simplified communication boards coupled or not with speech synthesizers.
13	Same answer as 2.1.
14	*No answer*
15	*No answer*
16	*No answer*
17	I stated my opinion about this category in answer to the first question.
18	Reliable, cheap, desirable (applies to all below).
19	Difficulty using services that require the user to respond with clear speech - use textphones or machines that provide voice equivalents such as the Claudius Converse allow response in text rather than voice Difficulty using services that require the user to read and understand written instructions or text displays - replace by spoken instructions, use clear simple language.
20	*No answer*
21	*No answer*
22	Communicating devices operated by pointing or touching a pad.
23	*No answer*
24	*No answer*
25	Specially adapted mobile phones, special computers, reading machines.
26	*No answer*
27	*No answer*
28	*No answer*
29	A way of communicating with other people e.g. in shops to say what they want. A way of communicating with professionals e.g. a doctor. A way of communicating with family and carers to show what they want or need.
30	Do not know.
31	*No answer*
32	Hand held communicators with speech output for people with speech impairments.
33	Synthetic speech devices.
34	*No answer*
35	*No answer*

2.5) People with multiple disabilities.

1	AT necessary, all of the above
2	See answers earlier
3	*No answer*
4	Yes
5	*No answer*
6	Combination of what I said earlier
7	*No answer*
8	*No answer*
9	All or many of the above.
10	Synthesis of all above
11	*No answer*
12	*No answer*
13	Same answer as 2.1
14	*No answer*
15	*No answer*
16	*No answer*
17	All kind of different input devices vis head movement, eye movement, facial muscles movement, etc. Dependent on the combination of disabilities, a mixture of devices mentioned earlier.
18	Reliable, cheap, desirable (applies to all below)
19	Impossible to answer - it depends on the combination. It may require a number of the solutions earlier, or a completely new approach. For instance, deaf/blind people with no useful speech or hearing will be reliant on Braille terminals and no other solution is likely to be effective. The more complex the disability and the greater the severity the more difficult the resolution.
20	a) public passenger transport: - design of e.g. railway stations: simple and logical design, use of contrastive colours and lighting for partially sighted passengers. - acoustic announcements, e.g. destination, single stops. - tactile floor indicators, e.g. for security reasons and for orientation. - accessible timetables e.g. via smart card which determines the special needs of the blind or visually impaired user by changing the interface of the device, e.g. acoustic signs or large print. - highly visible, tactile embossed and concise signs, e.g. acoustic announcements or/and Braille letters in elevators, tactile maps. - available help from staff members as flight assistants, "train assistants" telephone hotline e.g. timetable. - assistance for mobility and orientation: - complementary systems to primary mobility aids such as long cane or guide dog: audible or tactile (Braille) GPS-system, object detectors as "body guard". - acoustic lighting signs at cross roads. b) use of public services as libraries, university, schools - accessible catalogues and database of libraries: available devices for blind and partially sighted users - for students: available documents, books, scripts in readable formats - tutors for more complex researches - for employees: working place-assistance for consultation of adequate equipment c) PC, computer systems - screen readers, speech output, Braille displays, - reasonable accessible software, e.g. using the Microsoft Windows Standard layout or allowing keyboard commands, shortcuts, hot keys, menus etc. - text based OCR-Systems d) World Wide Web accessible webpages for blind and visually impaired users logical and simple structure alternative text for describing images or image links user definable colours, fonts and text size for partially sighted users. - descriptive and clear link names, page titles etc. - available help system when the page is constructed in a more complex way. - avoiding purely graphical information which is essential for the user. - providing a text version but only if no other solution is possible!. - consulting databases, informative webpages, catalogs, timetables (travel planning). - purchasing products, shopping. e) literature procurement - development of good OCR-systems - E-Books: sale via internet - E-Books, e.g. dictionaries on CD-ROM: accessible format - development of new formats as the Daisy-Format: audio book with hyperlinks and HTML-Text for Braille reading. f) aids for daily life. - medical assistance: devices for monitoring blood pressure or blood sugar - scales - watches, clocks - notetakers, organizers - providing accessibility to nowadays complex devices as telephones, mobile phones or recording devices as minidisc players CD-players.
21	*No answer*
22	Voice activated computers and household devices.
23	*No answer*
24	*No answer*
25	Specially adapted mobile phones, special computers, wheel chairs.

26	*No answer*
27	*No answer*
28	*No answer*
29	Communication with other people, a way of getting through to people what the person needs.
30	Deaf Blind people would need computers with a Braille keyboard and a Braille bar in order to communicate and read texts.
31	*No answer*
32	A combination of all the above-mentioned aids plus simplicity.
33	All above.
34	*No answer*
35	Combination of elements of the above.

3) What are the most important requirements for assistive technology (for instance weight, cost, portability etc) for people in the following categories? Please answer for all categories that you have knowledge of.

3.1) People with physical disabilities.

1	Light weight, durability.
2	In reach.
3	*No answer*
4	Portability, cost, usefulness, easy to use, maintains, support/training.
5	*No answer*
6	Portability, weight.
7	*No answer*
8	*No answer*
9	Portability, weight, cost.
10	Weight, portability, cost, ease of operation and access.
11	*No answer*
12	*No answer*
13	Cost is probably the most important factor here, particularly if the state does not either supply it or in the event of an individual working, if the state does not subvent the cost of the item. Unfortunately, the vast majority of disabled people do not work, so therefore that has to play a major role. Also the portability and the ease of use would be the major factors from my point of view. I believe that this answer is applicable to all the categories.
14	All are important
15	*No answer*
16	Cost for all kinds of technology is very important (economical accessibility) - compatibility with products for all.
17	Weight, portability, special design, and good ergonomical design.
18	Attractive design.
19	I find it impossible to answer this category by category, as the requirements are very similar for each group. Cost is always one of the most important, since those with disabilities are likely to be among those with the least disposable income to be able to afford solutions. The difficulty again is that the greater the severity the higher the cost is likely to be, not least because the size of the market will be smaller. For instance, VersaBraille terminals for the 23k deaf blind people cost upwards of £5,000 (and are no longer available anyway). Textphones for the profoundly deaf (who number about 160 000) cost around £200, though BT has just launched the first rental textphone as it acknowledges this problem. Equipment can be obtained under the Chronically Sick and Disabled Persons Act and also under the Access to Work scheme, but this is not a solution for everyone and there can be delays using these means. So cost is easily the most important factor. The next in importance is universality of standards and interfaces. For instance, many heard of hearing people cannot use a digital mobile phone as it interferes with their hearing aid. A neck loop can be a solution to this (though again it does not suit everyone) but few firms make these, and they only fit their own equipment as there is no universal interface. Radio technology such as Bluetooth may help here, but government agencies are reluctant to legislate to ensure common standards. The third in importance is ease of use. By its nature assistive technology is likely to be complex as it is in addition to the normal usage. Equipment needs to have clear instructions, and the most commonly used parts should be easy to operate and should not require a complex series of operations. Fourthly I would place portability, though that is not always required – it depends on what the assistive technology is to be used for.
20	*No answer*
21	*No answer*
22	Weight and portability would be the most important.
23	*No answer*
24	Weight is of course an issue for the portable products since you often have to carry more than one (see earlier) – and portability is important because you need to be able to communicate outside your home like everybody else, perhaps even more so. The same goes for price – often you pay more than double for a product you can use when you have a handicap. Ideally all products should be designed to be used by everyone (as mentioned in 1) that way this would not be as big an issue. I would also like to add timeliness as an important factor. When a new product come out where you need to use assistive technology it is important that that assistive technology is available for you. Often you have to wait, sometimes for years.
25	Cost –weight –portability.
26	*No answer*
27	*No answer*
28	Cost, weight, portability.
29	I would have thought that weight, cost, portability, ease of use, inconspicuousness (a new word that you can put forward to the OED) would apply to every category. Also, future proofing and compatibility with other technical items. They also need to be useful in practice and not just in theory.
30	Cost and weight would be the two major requirements for all categories.

31	a) The importance of price depends on systems of financial support existing in a given country. The part of the price not covered by support schemes or which could not be paid from incomes dedicated to compensate consequences of a given handicap should not significantly exceed costs of equipment and/or services used by sighted people to access the same information. b) A very important feature is universality – the number of different needed assistive devices should be as small as possible because access to ICT is needed by and could be helpful for visually handicapped people still more frequently. c) High portability including low weight, small dimensions, high level of independence on power supply, and universal connectivity to different kinds of ICT is of a great importance because access to ICT is needed in different places and in different situations, not only at home, at school or on a given working place.
32	In all cases, cost, portability, simplicity and availability.
33	Cost, weight, adequacy to physical problem.
34	The Assistive Device's cost and reliability for all categories of the disabled people.
35	In general: portability (possibility to take it with you in all circumstances, so preferably wireless) and the total reimbursement of the costs by government, social welfare etc. Depending on the type of physical disability - For people with limited movement function: • Weight. • Anti-slip material. • Compact. • Smooth surface (sunk buttons), so that hands can easily glide, over it. • Possibility for alternative input (e.g. input for external switch) in case of change of physical situation (e.g. Multiple sclerosis) • Light touch buttons, close together - For people with physical control difficulties (e.g. spastic). • Strength of the material (e.g. shock-resistant). • Not too compact to allow uncontrolled movements. • Anti-slip material. • Big buttons, that require some force to push, in order not to be activated "by mistake". Wide apart to prevent pushing wrong buttons.

3.2) People with sensory disabilities.

1	Light weight, durability, extended battery life.
2	*No answer*
3	*No answer*
4	*No answer*
5	Cost and reliability, universality - that is to say that there should be adaptive facilities in all applications where handicapped people are presented with an interface to information. If built into items like ATMs and touch screen information systems as a standard part of the circuits then the relative price would drop dramatically. It would also influence the social acceptability of handicapped people (but that is another issue outside the scope of this survey).
6	Portability, weight, cost.
7	Most important requirements for assistive technology for people with sensory disabilities are: small size and great - easy portability - acceptable price-utility relationship - auditory output via standardized infrared interface and standardized scanning devices.
8	Cost, paid by insurance, training possibilities to use it, help desk as back up, accessible design (for example with services via terminals like ticket machines and ATMs), multifunctional (not for every instrument a different assistive device), state of the art, useable for all brands so that one can choose from different suppliers.
9	Portability, weight, cost.
10	Cost weight, portability, ease of operation.
11	Cost: many visually handicapped people cannot go to work and get very little money from the government. Weight: important for things, they carry around daily, for example the pocket-counter for the euro. Colour: strong colours and big contrasts (letters and background).
12	*No answer*
13	Same answer as 3.1.
14	*No answer*
15	Portability and weight and that the equipment is easy to handle is most important. Of course, the cost is important too, but if the equipment is cheap but heavy and difficult to handle it is of no use.
16	*No answer*
17	Cost, portability, scalability, and good intuitive design.
18	Simplicity of use. Inconspicuous.
19	See 3.1 earlier.
20	*No answer*
21	Blind and visually impaired people should have the same possibilities as others, therefore it is important to keep costs low and to raize the awareness of their special needs in society. Traffic and buildings: If tactile floor indicators, acoustic traffic lights, tactile and acoustic information in pubic places (railway, stations, government) are planned before construction they need not be adapted. This keep costs low. Aids for computer: Special software as screen readers and software for speech output must be cheap but of high quality. Otherwise nobody would employ impaired people for economic reasons. Things for daily life: VI: If things for daily use were designed more carefully there would not be the need to adapt them for visually impaired people: B: Most things could be adapted easily and with low costs if the producers thought of that before creation and construction. (Positive example: on the market, there are many talking watches with low price.
22	Efficiency; portability; weight.
23	*No answer*
24	*No answer*
25	Cost –weight –portability.
26	For people with visual impairments portability and cost are the most important criteria. The prices of any assistive technologies available now are extremely high, much too high for an average person to afford. At the same time these technologies or equipment is also quite big, very sensitive and thus not very useful for carrying it around with you.
27	The most important requirements are technology following the general marked. Technology building on the same programs and services the rest of us are using. A lot of disabled people works with old out-of-date systems and do not get the full potential of the technological development.
28	Cost, portability, speed of reaction.
29	If using for communication e.g. a deaf person talking to someone then the interface to speak and reply needs to be easy to understand for people who have not used it before.
30	Cost and weight would be the two major requirements for all categories.
31	*No answer*
32	In all cases, cost, portability, simplicity and availability.
33	Cost, flexibility, portability.
34	*No answer*
35	Ability to track the device by beep signal (e.g. whistling keys that make a sound when you whistle so that you know where they are) for blind people - Braille indication on all buttons for blind - Ability to track the device visually or to see visually when interaction is requested (e.g. blinking light to indicate phone is ringing).

3.3) People with cognitive disabilities.

1	*No answer*
2	*No answer*
3	*No answer*
4	*No answer*
5	Cost and reliability.
6	*No answer*
7	*No answer*
8	Cost, paid by insurance, training possibilities to use it, help desk as back up, accessible design (for example with services via terminals like ticket machines and ATMs), multifunctional (not for every instrument a different assistive device), state of the art, useable for all brands so that one can choose from different suppliers. connectivity, cost.
9	*No answer*
10	Portability, weight, cost, ease of use.
11	*No answer*
12	The key is adaptability of the assistive technology to the learning and communication difficulties of each person. Most programs are not open enough to allow changes of parameters such as speed, type of illustrations, simplification of exercises, number of items on a communication board, etc. The software should be robust more than the hardware. It should be tested as not to fail in the middle of an activity as the person will most likely not be able to restart the program, and worse will not know how to recuperate his/her work.
13	Same answer as 3.1.
14	*No answer*
15	*No answer*
16	*No answer*
17	Simplicity of input and output, cost, scalability.
18	Desirability.
19	See 3.1 earlier.
20	*No answer*
21	*No answer*
22	No experience.
23	*No answer*
24	*No answer*
25	Cost –weight –portability.
26	*No answer*
27	*No answer*
28	Cost, equipment adaptable to many different types of handicap.
29	*No answer*
30	Cost and weight would be the two major requirements for all categories.
31	*No answer*
32	In all cases, cost, portability, simplicity and availability.
33	No experience.
34	*No answer*
35	User-friendly. Easy interface. Attractive, colourful shape.

3.4) People with communication disabilities.

1	See earlier (light weight, durability, extended battery life?).
2	*No answer*
3	*No answer*
4	Ease of use, cost, appropriate, flexibility, portability.
5	*No answer*
6	*No answer*
7	*No answer*
8	*No answer*
9	Connectivity, cost.
10	Weight, portability, cost, ease of use, use of symbols, icons.
11	*No answer*
12	Same comments.
13	Same answer as 3.1.
14	*No answer*
15	*No answer*
16	*No answer*
17	No special devices required.
18	*No answer*
19	See 19 earlier.
20	*No answer*
21	*No answer*
22	Efficiency; portability.
23	*No answer*
24	*No answer*
25	Cost –weight –portability
26	*No answer*
27	*No answer*
28	Cost, compatibility with other types and brands of equipment.
29	Ease of use for other people and ease of understanding of any output. If you are using a device with synthetic speech output to communicate with other people then the synthetic speech needs to be high quality so that someone unused to the speech can understand it. Also, if the person needs to use the device to reply then it needs to be clear how they use it and must have a standard input e.g. keyboard.
30	Cost and weight would be the two major requirements for all categories.
31	*No answer*
32	In all cases, cost, portability, simplicity and availability.
33	Cost, portability, flexibility.
34	*No answer*
35	*No answer*

3.5) People with multiple disabilities.

1	See earlier (light weight, durability, extended battery life?).
2	*No answer*
3	Cost/performance (that is real increase in accessibility and usability of information technology and telecommunication systems) is very important. Most assistive technology products are considered too expensive mainly because the benefits are only marginal. Ease of use, and the earlier (cost, appropriate, flexibility, portability?).
4	*No answer*
5	*No answer*
6	*No answer*
7	*No answer*
8	Design for all is what should be the starting point, but that does not mean that there will be no more assistive devices. There will be always situations were people are only helped with assistive devices and these must state of the art and covered by health insurances.
9	Portability, connectivity.
10	Synthesis of all earlier.
11	*No answer*
12	*No answer*
13	Same answer as 3.1.
14	*No answer*
15	*No answer*
16	*No answer*
17	Dependent of mixture of disabilities. The devices usually cost fortune, so low price would be desirable.
18	*No answer*
19	See 19 earlier.
20	a) Public transport - cost - measures should be understandable for all passengers; if not there can be big problems of acceptance, e.g. acoustic lighting signs at cross roads amount of noise - special design and equipment should be planned and built in from the beginning, for example it is much more expensive to adapt a railway station to the special needs of handicapped people after it has been finished. Electronic devices - costs, especially if they are financed privately - weight and portability, e.g. for orientation devices (GPS-System) - portable computers become more and more popular. New challenges with small devices: small keys and especially multifunction keys tiny displays very complex tutorials not always understandable for blind and VI users.
21	*No answer*
22	Efficiency.
23	*No answer*
24	*No answer*
25	Cost –weight –portability.
26	*No answer*
27	*No answer*
28	Cost (for most people, financial possibilities are inversely proportional to the number of impairments).
29	Ease of use for other people and ease of understanding of any output. If you are using a device with synthetic speech output to communicate with other people then the synthetic speech needs to be high quality so that someone unused to the speech can understand it. Also, if the person needs to use the device to reply then it needs to be clear how they use it and must have a standard input e.g. keyboard.
30	Cost and weight would be the two major requirements for all categories.
31	*No answer*
32	In all cases, cost, portability, simplicity and availability.
33	*No answer*
34	*No answer*
35	*No answer*

4) What future developments in information and communication technologies will have particular relevance to people with disabilities?

1	Cell phones and other communication devices, smart cards, public terminals such as ticket machines of all kind and information dispensing units, smart houses (particularly for people with multiple impairments), personal digital assistants.
2	Speech recognition.
3	Any development aimed to introduce the requirements of people with disabilities in the specifications for the development of new product in the information society.
4	Portability, flexibility, convergence in technologies (media communications; etc).
5	In the nature of things IT will get smaller, cheaper and more reliable. But at the same time the manufacturers increase the power and capability to keep the price up. The more that accessibility standards are pressed for and laws such as the ADA make manufacturers such as Microsoft aware of needs then there is an increasing chance that the amount of adaptation for specific handicaps will be reduced. "Standard" solutions for standard handicaps might just become standard components as the market recognizes that such facilities can be useful for a much wider target group.
6	Reading device for displays and output in Braille and/or speech and/or large print. - External input device to communicate with different machines.
7	The following developments of ICT will have particular relevance with people with sensory disabilities - integration of hitherto separate devices or componants into multimodal and multifunctional systems - ubiquitous availability of electronic information output (e.g. scanning of price labels, medicinal product information, etc.) - auditory interfaces, in particular speech output and speech input integrated in all relevant devices.
8	Developments in e-book, digital rights management, copyright, antidiscrimination act to ensure accessibility, to force industry, accessible web design, accessible graphical user interfaces, usability of telecommunication (mobile telephones) to get all sorts of information, for example as GPS and mobility, for info on train schedules. development in smart cards etc.
9	Email, text messaging via voice, greater enhancement of speakers quality, enhanced hands free sound quality.
10	Convergence will accelerate, processing power would multiply exponentially, nanotechnology would be part of the convergence process, speech recognition would be more accurate etc.
11	When people with visual defects will be integrated in our common life one day, the whole developments will be interesting for them.
12	In the case of Intellectual disabilities, we must develop a lot more "Artificial Intelligence" in order to guide the person's attempts to access to information. For example, the programs should be capable of detecting that the person does not understand what is going on and gently propose explanations at a different level, more understandable than the initial level.
13	I believe that we have only begun to see the benefits that this sector can bring to disabled people throughout the world. It should assist a large percentage of people to be able to access, through the mainstream, in a similar manner to other citizens. This would be a vital breakthrough and would assist us in ensuring that disabled people are seen as full citizens.
14	All development that permit a higher degree of independence and self-control.
15	I think that the development of technical aids that can help visual impaired people with orientation and finding their way (e.g. GPS) will be very important.
16	Access to mobile telephony and internet (e-commerce in particular).
17	Future development is dependent on a view one can take on today's development. I am not a mage to be able to tell the future, but have given some thought about the future, and here is my view: Next step in communications is mobile video-phone with mp4 audio-video compression, something like Emblaze serve servers-encoders. It would aid the deaf. Furthermore: Integration of mobile telephone and laptop PCs shall aid the deaf, and hard of hearing mostly, and people in wheelchairs. Blind people will get more and more powerful and affordable notetakers, and i-machines (Like Pappenmeier's "ELBA"), and through them can communicate with everyone. I do not think mobile telephones with "design for all" approach have future (as Mr. Zagler from Linz university advocated on ICC2000 Conference), as the production will be too expensive. Another example is DAISY talking book, where a standard for talking books is advocated by many. More cheap approach in digital talking books are MP3 players capable of reading IDT tags, and they will "eat" DAISY standard in coming years. In short: I see development aiming toward cheap technology for mass, which will serve disabled people with only few adjustments.
18	Standardized consumer interfaces. Standardized device interfaces (e.g. Bluetooth or whatever). Standardized software interfaces. Minimal maintenance, including batteries.

19	I think two things stand out here. The first is convergence - whereas up until now users have required several pieces of equipment each carrying out distinct functions I believe we are going to see equipment able to perform a wide range of functions. For instance a mobile phone terminal can already make phone calls, send emails and faxes, access the Internet and allow you to watch television. As convergence increases, as it will, I believe it will make it easier to add features that benefit disabled users to mainstream products, so that assistive technology will become increasingly part of inclusive design (I prefer that term to Design for All, which is outdated and increasingly a misnomer, so that I am surprised to find it used in this questionnaire). The second I alluded to earlier, which is Bluetooth and similar technologies, that will require less and less dependence on hard wired equipment. This should make interconnection of different pieces of equipment and universal interfaces much easier to achieve, and I believe this will benefit disabled users enormously. The Internet itself is a very potent force, both as a means of communication and as a levelling mechanism. Using the Internet disabled people are often and increasingly on level terms with the rest of the population, and thus more able to participate in the same things as everyone else. This is obviously something to be encouraged.
20	Development in communication technologies, e.g. mobile phones (UMTS) - WWW: new technologies. Development of accessible archives. Interactive technologies: webpages, communication with other users (distance learning, online training). The media on the internet. Shopping on the internet. Financial transactions e.g. telebanking. Electronic signature.
21	WWW: In all parts of our lives from the first lecture to education (virtual school) to the university and finally the job, ordering and selling. Computer: Screen readers must be developed also in future to assist us in using modern computer technology. Transport: Buying tickets, moving from A to B and finding the way must be assisted by acoustic traffic lights, tactile floor indicators and special speech output for all machines. Daily life: All things like lifts, telephones, washing machines, automatic doors must be adapted so that blind and visually impaired people can use them also in future.
22	The development of the web could be an exciting opportunity to level the playing field. However, the needs of the disabled do not figure in the economic arguments for product development and so accessible components are not designed in at the initial stage. Equally, hooks are not built in for external adaptive devices. Note the development of the mobile phone - a perfect audio device that has been corrupted into a visual device without reference to its audio capabilities that would have included users with a visual impairment. American legislation is now putting enormous commercial pressure on manufacturers to make all their devices accessible in order to be purchased with Federal Government funds.
23	Cash dispensers and other machines for money transactions Mobile phones For blind people and persons with visual disabilities: Acoustic information systems in public places Telematics systems Passenger information systems (e.g. timetables) should be accessible by computer from at home as well as in the train or bus station. Forms of giving directions so that blind and visually disabled persons may find their way Induction loops for persons with hearing aids (e.g. at counters/ booking-office windows).
24	The new technology offers a lot of possibilities but also problems. Possibilities because a lot of thing will be technically possible in the future - especially regarding speech. And things like mobile phones will come with the possibility to have extra storage space (external flashcards) and the possibility to download personalized user interfaces (e.g. with speaking menus). With 3rd generation mobile communication we will also have the possibility very easy to send things like wave-files over the air which will make it easier to exchange sound. But there is always the danger of things happening so fast that we never get around to having the right assistive technology and thereby not the same possibilities. And for the visually impaired there is also the danger that the world is getting more visual and that producers and manufacturers do not take people with visual products into account when they design - and we have not been good enough to see into the future and predict the new products and make our demand in the developmental phase.
25	Low price. Compatibility with everyday technology. Vocal indication (synthetic - artificial voice etc).
26	The first is to make the price more accessible. This, I think, might happen with the change of production technology, if the cost of production itself can be lowered. I think we have to work towards simplifying things, to make them usable also for people with multiple disabilities. For people with visual impairments the most important developments will surely be in speech synthesis, and in designing tactile (touch) information technology, which would not depend so much on graphic design.

27	Developments allowing people with disabilities to run the same information highway as the rest of us. We need a way to access a lot of future services coming with 3rd or 4th generation cellphone-nets. We need systems to use a future high-speed internet. So a way to build systems that follow the general marked development in a quick and speedy way. I believe very much in specially designed user interfaces using mouse, touch, voice, contacts or other means of navigation.
28	Mobile devices, relay services between persons using different modalities, access to complex software. May I refer to: "Study on Technology Trends and Future Perspectives within Assistive Technologies" (The Thys Soede report).
29	High speed communication lines will help with downloading stuff onto PCs. It will also allow for graphics to be downloaded quicker which will help people who have problems with text. To some extent miniaturisation but for people with visual impairments who want magnified output then miniaturisation would not help unless this is catered for.
30	Accessibility - integration. As far as possible should IT for the "normal population" be accessible to disabled people. Design for all.
31	Design for all will have particular importance in development of ICT. It will hardly provide general access to ICT by itself, but it could significantly decrease need of assistive devices and to provide a universal interface and enabling to connect assistive devices when needed.
32	Anything that brings about access to information, independence, access to the community, in general, to be able to live an independent life on an equal footing as able-bodied people.
33	Mobile communication (voice and data), automatic translation of information media: text to speech, speech to text, graphics to verbal description.
34	For visually impaired people the following below developments in ICT will have particular relevance: Means for free barrier access to World Information Networks: - text description of Web page graphic elements - voice-activated Web navigator agents - Advanced developments connected with future communication: - use of satellite navigation systems (such as the American Global Positioning System) coupled with the Electronic map of the area for orientation of the blind and visually impaired - mobile telephones as a location system that are portable and very comfortable ones for communication at a distance - Introduction of digital TV that ensures starting such services as audio description For people with residual vision a Virtual Retinal Display (VRD) that beams information and images directly onto a retina from a tiny device mounted in the frame of a pair of glasses.
35	According to me, the exponential growth of the e-Society offers tremendous possibilities for people with a disability and will undoubtedly reduce the need for assistive devices. Very soon we will be able to perform almost any daily activity by means of an e-alternative. So there will be a great need for training of disabled people by peers in order to teach them how to use these new ICTs as a (partial) compensation for their disability and to enhance their participation in mainstream society.

5) Do you have any other comments on the future of assistive technology?

1	Standardization in AT is crucial on the way to universal accessibility. A design for all approach in the development of ICT products and services is preferable since it is bound to significantly reduce the cost of accessibility.
2	*No answer*
3	I hope that the space of assistive technology in the future will be reduced to the problems of some of the groups of people who are severely disabled. The majority of citizens should be served by general purpose technology.
4	User involvement at design stage. The whole area of HCI and how that needs to be changed within a universal design philosophy.
5	Yes but it would take a whole book to describe them.
6	Devices have to be independent of language and character set.
7	*No answer*
8	Design for all is what should be the starting point, but that does not mean that there will be no more assistive devices. There will be always situations were people are only helped with assistive devices and these must state of the art and covered by health insurances.
9	Yes, ongoing ring fenced funding for research and development along with the means via government grants for individuals needing the equipment to buy it or supply via social services.
10	It will continue to exist for a very long time to come, as standardisation and design for all have their limits.
11	I hope this is a growing branch.
12	Development should be made by pluridisciplinary teams including people with disabilities, professionals of assistive technology, of ergonomics and psychology that can analyse Man-Machine interactions from a physical and a cognitive point of view.
13	There should be much more interaction with disabled people through their representative organisations, that is organisations controlled by disabled people. For too long the professionals, who have a vested interest, have been the main spokespeople for disabled people. I believe that we now have enough disabled people with the knowledge and expertise to assist in developing and marketing assistive technology.
14	a good combination between assistive technology and general would be the most beneficial.
15	I have not enough knowledge to comment this.
16	Many developments seem to be based one the use of written information on screens. The access can in consequence be very difficult (contrast, pitch...) for those with visual impairments.
17	I think mainstream technology will use lots of knowledge from assistive-tech designers, and make mainstream tech-devices that will be very cheap compared to today's assistive tech devices. Less and less will assistive devices be needed, because mainstream will solve most of the problems in weight, portability, design and including all perception modalities.
18	See the excellent report by Price Partnership and iRv "Study on Technology Trends and Future Perspectives within Assistive Technologies".
19	No.
20	*No answer*
21	If developers would not only see the young and fit generation but also their own grandmas, modern technology could be of much help Instead of that many products for daily life must be adapted later on with high costs. This could be avoided by checking before constructing. (It is the old generation that mostly pay the "toys" for the younger.)
22	Assistive technology should, ideally, be a passing phenomenon. The adaptive solution would emerge in the form of an Assistive device and this solution should then be designed into the device or system being aided by the Assistive technology. However, this depends on market forces and the possibility of inclusion of the Assistive solution is ignored. It is essential to change the culture that ignores the needs of all and designs exclusively for a selected market sector. Technically, it is easier to design-in for the disabled than to add an adaptation later. It is also considerably cheaper to do so.
23	Yes - see my comment after question 1.5
24	Just that it is my hope that more products in the future will take everybody's needs into account, so that assistive technology will be less required - but we will not be able to get rid of it all together no matter how much we design for all.
25	I would really be very glad if someone could explain me the rational or technical reason why the layout of the digital keys on the telephones is different (upside down) to the layout of the keys on numeric part of computer keyboards and cash dispensers etc. I see no reason for that difference which makes a lot of troubles to blind or partially sighted people and most of older generation
26	*No answer*
27	*No answer*
28	Design for All (i.e. design for a larger group of persons) will never cover the needs of all handicapped users. Assistive technology will remain but for smaller groups.

29	It has to fulfil a real need and work in practice fitting in with people's lives easily. Technology is a means to an end not an end in itself and as long as design takes this into account it should help. Also, people do not want too many add ons, inclusive design should reduce the number of add ons needed and standardization is needed so that if people can plug in some bit of kit to get access to something then it needs to be the same one for everything not one bit of kit for a BT phone, another for an AT&T phone, another for those phones in orange boxes that I cannot remember whose they are, etc. Or if it is for access to ATMs then it has to apply to all of them not just one type.
30	That it will be cheaper.
31	Design for all should be preferred wherever it is possible. If assistive technology is needed, the software solution should be preferred. Assistive features of ICT should integrate handicapped people, not to segregate them.
32	No
33	In many cases the need of assistive technology would decrease if general technology would be more accessible (design for all).
34	*No answer*
35	The more the ICT will grow, the less need there will be for assistive technology. In any case, constant dialogue with the disabled end users is a necessity in order to determine their specific needs and focus the production of new AT devices on those requirements.

6) Can you tell me in your opinion at what degree of disability will a user have to use assistive technology rather than design for all?

1	If a design for all principles are seriously implemented to include the needs of elderly people, only in severe cases of multiple disabilities will the use of additional AT be necessary.
2	That is a difficult question because there are so many different disabilities. I think that it is important that design for all has to cover 80% of the total group of people with disabilities.
3	*No answer*
4	For the foreseeable future it will be most people with a disability, as design for all has still a considerable way to go to incorporate the needs and requirements of people with disabilities.
5	Design for all cannot actually be for all since so many handicaps require individual solutions. However the principles of design for all if universally applied would enable people with what we might call standard" handicaps to access information. This would then make the development of specific solutions so much easier, faster and cheaper. It would also make a radical difference to the lives of many millions of people in Europe alone.
6	In Austria, we have a system of governmental support for disabled people. Every person who needs this support will also need to use such devices.
7	Assistive technology rather than design for all will be required normally at visual acuity level of less than 0.3
8	That all depends on the circumstances. The circumstances can make someone more or less handicapped and determines the need for assistive devices. And also the degree to which someone is computer literate or not; not everybody is able to learn this properly.
9	20 %.
10	When they can no longer access design for all products.
11	When people see less than 50%, they need assistive technology.
12	Even the smallest disability should benefit from assistive technology. What is at fault is the design of "products for all" most of the time. Design for all should be as much as possible including features that allow use by people with disabilities. For example all computer keyboards have two keys comporting a tactile system (the F and the J) that help people with a vision disability to locate their fingers positions on the keyboard. If one had had to design specific keyboards besides keyboards for all, the special keyboards would have cost a hundred times more. So the idea is to imbed as many as possible specific devices in "design for all" products. In the case of intellectual disabilities, it would be through allowing parameterization of the software.
13	If Design for All is used, then it should be for all and not for the majority. Therefore, there should be no need for specialised equipment.
14	Does not necessary depend on degree of disability alone but also on resources, personal attitude and interest
15	I think that people with more severe degree of disability always will be dependent of assistive technology. I think also that "Design for all" perhaps is an Utopia – a far away goal to strive to until then assistive technology will be important for most visual impaired people.
16	Design for all in the better solution for everyone, as long as the user have an access to the product or service. Assistive technology should be used for severe impairment, when the compromise is not possible, for technical or economical reasons, with design for all.
17	Has to be VERY disabled. Multiple disorders, and people who are not able to move hands and legs. Not just deaf, or just blind or just distrophic. These categories alone can do well in the future without assistive tech, only using mainstream tech.
18	AT can be used by anyone with any disability. Reading glasses are AT. Special classes of AT may be defined (e.g. State-supplied), but these are a subset of AT in general. "AT" does not define degree of disability.
19	As I have said earlier I do not like the term Design for All – there is no such thing! The correct term, which is the one now used by the majority, is inclusive design, which is including in the mainstream things which will benefit the widest possible range of users. As a rule of thumb the more extreme the disability the less likely the solution can be achieved through inclusive design and the greater the likelihood of the need for specific assistive devices. Apart from anything else, the more extreme the disability the fewer people there are requiring the solutions, so the more costly they become to develop as the market to retrieve the costs is smaller. You are more likely to find a manufacturer including a feature that will benefit a large number of customers than one that will only benefit a few. Thus speech recognition is developing because it not only helps disabled people with various disabilities but because business users are increasingly finding it quicker and easier than having to type on a keyboard. On the other hand Braille terminals are never going to be part of inclusive design as they only serve a specific and small set of users.
20	"Design For All"? I am not sure what "all", means: the average person who has absolutely no problems reading all information, climbing hundreds of stairs, understanding all interactive electronic systems. I would propose to define our society as a the result of individuals and minorities with special needs. So we could find solution acceptable (not ideal) for all of us, regardless of our special needs.

21	This is depending on education, time of getting the disability and personality. I can only use an example: If you have to buy a ticket the automat should be – visible from a great distance - clear in design so that you do not need assistance to chose the right button - everything should be readable also for elderly people that do not have a visual impairment without spectacles there must be enough time for the user to chose in a menu But: A totally blind person simply needs more assistive help but for most of the visually impaired it would be helpful to take more care of design.
22	This depends on your definition of Design For All! My definition is that all varieties of user must be catered for even if this leads to a modular solution with the customer selecting a personal range of functionalities in the shop. From your question I assume you to understand that design For All means designing for the lowest common denominator and therefore assuming full functionality in the user. If this is the case then I cannot agree with your definition. If Design For All has been applied to the development of the product then no Assistive device will normally be necessary. However, if a loss of functionality arises that has not been anticipated by the designer, an Assistive device will be needed. However, the core of the operating system of the equipment that has been "Designed for All" will be fully accessible to the designer of a new Assistive device unlike present systems.
23	This strongly depends on the type of machine, its kind of construction and the dexterity of the person in question. As the needs of people with disabilities are taken into account less and less often (keys are getting smaller and smaller, only visual feedback is given), it is getting increasingly harder for persons with disabilities to use new machines "designed for all". In the case of computers a central problem is that operating systems and programme versions (Microsoft) are changed very frequently, so using a computer is getting more expensive and harder for people with disabilities, who need expensive additional, adapted software, which has to be changed as often as "conventional" programmes or operating systems are modified. This especially applies to blind people.
24	It mostly depends on the way the product is designed - if you have the option to have inbuilt speech whenever there is a display you are less likely to need assistive technology even if you have completely lost your eyesight. There is though one objection to this. Blind people have their own written language, Braille, and it is important that there are things like Braille displays for computer and such so that not everything is speech because you learn better when you also have a written language. I also think that the need for assistive devices increase when you loose more senses or they weaken - when you are both deaf and blind you certainly need assistive devices since you have to rely on tactile information and Braille for instance. The same goes when you loose memory, since visually impaired tend to rely on their ability to remember.
25	As far as I know and to my experience nobody will use assistive technology if he does not have to. If Design for All would really be for all, nobody would have used Assistive Technology it is namely expensive, difficult to find and choose the right device, often unpractical to be used at different places (problem of portability!) and needs special skills to be used. At the same time work with it is not as easy as work with normal equipment for people without disabilities. For instance: very few performances of the mobile phones can be used by visually impaired people, because of little keys which are not marked good enough and because there is no voice screen reader of the menus and indications on the screen.
26	This is a difficult question to answer, since that depends on every individual. I could not give a figure; say people with less than 5% residual vision have to use the assistive technology. The only logical answer is that they need it when the design for all is no longer sufficient. But this depends on various factors, such as cognitive skills, orientation skills, memory skills and the frequency of use of this ICT, and not only on residual vision.
27	Let us keep the idea about the individual person in the centre going. Design for all is in my opinion only an idea working too far. You will never get rid of the need for assistive technology all together. But the market today looks at me as an individual user - let us do the same when it comes to the disabled user. He/she to is an individual with specific needs. So let us build mobile phones with Bluetooth technology so the blind can get information about public transportation when he needs it. Let us make information system working after the need of the person accessing the system with a electronic card with personal information. And let us build portable Braille systems.
28	There are no general rules for this.
29	I do not think this is answerable as a general question. It does depend on the thing in question. I think design for all should cater for different inputs and outputs but then there is a very grey area as to who can use it without assistive technology. It also depends on financial constraints as if it is going to cost double the amount to make something accessible and you need thousands of them across the country and a small, portable, easy to use, cheap assistive device can achieve the same access for a tenth of the price then this is relevant.
30	When you are totally deprived of a sense or two like deaf-blind people you have to compensate. However when it comes to audio also blind persons could use the same devices as sighted. I am thinking of a talking book player. The good old cassette player 2 track could actually be used also by blind people. Mobile impairments i.e. when you cannot use you hands is a severe handicap that has to be replaced with devices. Learning disabilities, a large field: people with dyslexics need speech synthesizers in order to get access to the content of texts.
31	There is no simple relation between degree of disability and need of assistive technology. In most situations the blind people and people with residual vision will be more dependent on assistive technology than partially sighted people. There are situations in which design for all could be enough for all visually handicapped people like talking cellular phone, if it is available.

32	When highly specialist equipment is required.
33	There is no general rule. It greatly depends on the type of disability, the activity to be performed, individual preferences.
34	A user have to use Assistive Technologies in case when disability restricts competitiveness of people in training and work activity, and there are no any compensatory possibilities connected with their inner physical and psychical resources. For example, lowering acuteness of eyesight more than 30 % without any opportunity of its correction by means of eyeglasses or contact lens.
35	I think the use of and need for assistive technology in the future will be limiting to those facing multiple disabilities, since it will be impossible to design a device counteracting all possible disabilities at once. Therefore, there will always be a need for AT, which might also become useful to non-disabled people facing similar problems (e.g. elderly)

Annex B:
Answers to questionnaire to disability industry

B.1 Answers

1) In your opinion, would it be useful for there to be standard interfaces between assistive devices and ICT systems?

1	Firstly, I would point out that there are three sorts of devices – from three types of organisations: a) Those that have been designed as Assistive e.g. Maltron, IntelliKeys, BigKeys LX, Penny&Giles b) Those that have had assistiveness "thrust on them". e.g. Kidsball, Pctrak, Mini keyboard. c) Those that are adaptations - e.g. Kidsglove, Ability-Switch connections for various mice.
2	Yes.
3	It could be useful if well-designed and flexible enough for future expansion. If implemented with no thought to the future, a standard could come to be more of a burden than a help.
4	Limited usefulness because only hardware interfaces can be standardized - with hardware manufacturers.
5	Most definitely. For example, had this been available with Windows from the start, many past and existing problems could have been easily avoided.
6	Definitely. It would simplify things where multiple devices are used no end.
7	Yes it would b useful if accessibility interfaces are standardized.
8	Yes, typically this can be accomplished by using a commercial, industry standard operating system that enables a disabled individual to interact with the assistive technology so that the results of their efforts might be compatible with those of their non-disabled counterparts.
9	Yes, direct serial connection, IRDA and/or bluetooth being the leading contenders for the actual communications hardware protocols.
10	Absolutely.
11	Absolutely.
12	Yes, we need standardization. More to the point, we need leaders willing to lobby for the standardization and follow through with the implementation.
13	I do not think the solution is to have a separate "standard" interface between assistive devices and ICT systems. Clients in a small marketplace who already pay too much and complain like hell should not have to purchase a separate interface. Rather the solution would be for the major computer companies to come up with a standard of their own that we can tap into and the stick with that standard longer than a fortnight.
14	Yes standardization of interfaces would be useful as long as the standardization process recognizes the principles of universal design in its development. An inaccessible interface would be a disaster if it is applied across all systems. However, since individual manufacturers are interested in developing their own unique market niches it is unlikely that they will be prepared to change to one interface. A comparison can be made to the building industry that has since the 1950s tried to standardize its processes with little success. The only system in the building industry that comes close is an "open " system called CLASP and was devised by Nottingham local authorities and even that has become less open and more "closed". The difference between an open system and a closed system is that an open system defines the criteria for anything to work within the system - in the case of buildings that is dimensions and tolerances of materials and elements of the building. Providing you element complies with the open system then it will work with any other element built to the open system. However a closed system is one generally developed by one manufacturer and allows their particular elements to work with each other. Little thought is given to how any elements from outside the individual manufacturer's system might integrate. Writing open systems is difficult in order to allow as many manufacturers to fit into it.
15	Yes, at least in the complex and expensive cases. Not for simple devices.
16	Yes there should be standard interfaces between the devices and ICT systems; this would help in standardizing setting up procedures and also keep the cost of providing and installing these devices down. If at all possible they should use existing interface protocols.
17	Yes, it would be very helpful.
18	Yes. It will enlarge the digital divide if there is an abundance of interfaces, each of which would have to be learned independently.
19	How can there be an answer other than yes? The provisos are whether the introduction of the standards stifles innovation and potentially increases the price of products.

20	Yes. But I believe that in many cases an existing standard can be used, and this is always preferable to creating a new standard. Where possible the interface should text based, since text can be easily translated into all modalities (print, speech, sign, Braille). The text should be marked up with HTML and XML to show structure and semantics. This argument leads to use of web interfaces. The assistive device is the client, and ICT system the server, or occasionally vice versa. A major advantage of such an interface is that it is distance independent. A disadvantage is the limited interactive possibilities of HTML - essentially there are only forms.
21	Yes, definitely.
22	Better interfaces between assistive devices and ICT systems would be very welcome but care has to be taken to define what is meant by "standard". There are potential problems. First, if a standard is enshrined as a legal directive or statute, it has to be policed. I know of companies that prefer to disregard standards and face the risk of fines if they are caught out, on the grounds that standards may be expensive to implement and difficult to include in product development. Second, a standard may have the effect of "freezing time" and stifling product development. The military field is notorious for this. For instance, the standard "MIL-HDBK-217" is widely used by industry to placate civil servants but is regarded by many as a costly way for achieving little. Nevertheless, 217 is often seen as a law. Third, standards may operate in competition with one another. There are directives to use more recycled products such as glass but glass is heavier than plastic and more difficult to lift for people with impaired hand function. I would like to see more evidence of "fit-for-use" in product design and that, in turn, means there is a need for better definitions for prescribing the routes for CE marking of products. To cite an example, a Zimmer walking frame is a class 1 medical device for the alleviation of a relief of handicap. However, an electronic voice in a passenger lift is accepted as a convenience for the general public even though it is also very important for a blind person to navigate around a building. Is the electronic voice in a lift an aid to "alleviate handicap"? Is it a class 1 medical device? Do we really want assistive devices to be classed as medical devices? Many companies still take the view that they will do not develop products for the "medical market" and people with disability and handicap are regarded as a niche market. I believe we should encourage the development of products as main stream consumer goods. My background is in physical disability, particularly upper limb disorders, and I believe there is a need to develop better interfaces for operating devices by hand. For instance, the typical consumer wants small mobile phones but small size inevitably means that the push-buttons must also be small. In principle, it should not be a difficult task to provide a mobile phone with an optional enlarged keypad – there is plenty of scope for mainstream products with optional extras.
23	Definitely yes! But equal emphasis should also be put in to researching and providing usability and inclusive design!
24	Yes, as an overall approach, but it can be a quite complicated subject.
25	Yes
26	Generally I think that a standard interface always is better. It makes it easier for the end user if you do not have to rely on just one manufactory to give you access. On the other hand, sometimes you have to go for a non-standard solution just to provide the end-users with something until the standard is settled.
27	Yes, of course.
28	I believe there should be a very simple interface between ICT and AD devices, so that they can co-operate and work together as one. The seamless integration of this is very important and more importantly one should not need a PhD to set-up and maintain. In summary extremely simple standard interface.
29	Definitely. If assistive devices need to communicate with other systems and/or devices, there must be standards which must be followed.
30	I do not think so. I think that assistive devices should conform to existing standards of various types, which seem adequate to the purpose. This will also permit best performance and best opportunity, since taking advantage of the "mass market" is really the only way that disabled people can really get what they need, in the long run (and I would be happy to elaborate on that and explain it more, with examples, if you wish). However, that presumes that existing interfaces are not designed in such a way that there are intrinsic limitations to the bidirectional exchange of information. For instance, the transmission of interface information in solely graphical form is useless for blind people, and hence interface standards in such a case should be changed to mandate multi-media transmission. Probably, straight digital transmission (at least being "available") is adequate to meet the need.
31	From an assistive device manufacturer's point of view, standard interfaces would clarify our product requirements and ensure our customers maintain some consistency in their equipment.
32	Absolutely yes. In our Walker, we are building a device that is "modular", in the belief that we can continue to develop the device and add functionality and features over time. We not only want to build autonomous devices, but ultimately complete smart homes where devices interact with each other and with the person. This will happen faster and better if all electronic devices have the capability to interact with each other at a basic level.

33	It would be useful for mainstream designers to have some standards to follow, as there seems to be none. If it is going to happen anyway it might be a good idea if assistive technology developers are at least aware.
34	If you are referring to hardware interfaces. I feel that the breadth and depth of the ICT applications that a disabled person may want to access, would make the task of defining one standard interface that suits, very difficult to solve. There is also the question of the standard interface being adaptable to the range and severity of the users' disability or aptitude. Also, should the nature of the input requirement of the ICT application change this would necessitate a redefinition of the hardware standard and expensive upgrades. If you are referring to data/command exchange interfaces then this may be more adaptable for the disability and the ICT application input/output evolution.
35	Most definitely yes!

2 What features should be covered by such a standard?

1	I agree it would be helpful if there were standard interfaces, but each of the above is different - very different strategic agenda, and differing financial constraints. a) can adapt quickly - if it is cheap, e.g. exchanging PS/2 keyboard interface for AT, but not if it is expensive e.g. Bluetooth. Some are very slow to respond to any change. (e.g. the Maltron has been around in its present form for 15 + years) b) Will adapt, in order to meet their main perceived market - if that loses the whole assistive value (as in the recent Kensington Expert Mouse changes) then tough. The assistive part of their market is sometimes not valued or even recognized. Often tooling costs will prevent a change (e.g. the Kidsball which remains serial only). c) The adapters will cope with almost anything, since they are often hand-built. However care is needed. For example, most mice can simply be ability-switch adapted, because there is a physical micro-switch inside the unit, and a handyman can parallel-up such a switch, and drill a hole for the cable connector. However, you cannot easily do that with chip-driven devices, such as the Cirque Glidepoint. As for hacking into infra-red, or Bluetooth! I know neither are rocket-science, but this would cut out 95 % of the Remap-type engineering assistance.
2	Communication ports to data storage, i.e. hand held devises being lost and having a storage back-up
3	I believe this question deserves careful thought. Most people, certainly including me, could give a list of only a few features that are , in the end, critical. I would certainly want information to be exchanged in a markup language. I would guess that 99 % of information one would wish to exchange with a household appliance or an ATM machine could be done in a subset of XHTML. However, this subset would be inadequate for many kiosks that need to pass on a map. We do not know today how to display a map easily to a blind person, but we sure would like to. And someday we will know, so we should not create a standard that locks in today's technology.
4	Braille input, speech input - as alternatives to keyboard and mouse. Braille output, speech output, tablet with tactile output
5	User interface input and output.
6	Ideally some sort of plug and play type system - i.e. automatic recognition of devices, and installation of software, etc.
7	Each ICT system apparently provides different functions and services. But, we should challenge developing the generic accessibility API regardless of ICT type. I am thinking in mind of some sort of macro or script controls.
8	Such a standard should be flexible and allow for the ability for a given product to create a comfortable, intuitive, and powerful environment for the individual to produce results and to progress through their day to day tasks by using the product. Different disabilities call for customized environments to enhance productivity.
9	To handle this, a query communications protocol should be established whereby the assistive device can query the ICT to find out what features it has, and determine by priority the type of features most likely to be used by the user. The assistive device can then present these to the user as selectable options. For instance, if the device is a cell phone, then the top priority option would probably be to make a call (dial a number), and second might be to answer a call. To accomplish this, the ICT must provide the assistive device with its full list of functions along with codes that the assistive device should send to the ICT to activate each function, and the tree structure involved in selecting a particular function. A full list of error codes should also be provided with their meaning spelled out in enough detail that the user can understand why the device did not respond as expected, and how the user/assistive device should respond to correct the situation.
10	All types of human-machine interface. However the ICT equipment is intended to be controlled by an able-bodied person (i.e. touch, keypad, etc) should also be controllable by another computer (via infrared, RF, and/or hard wire). There should also be a mechanism for the ICT to transmit what its user interface looks like (I am an elevator with 16 floors and my buttons look like this...").
11	I do not understand the question.
12	I am over my head here. The problem in the area of blind navigation systems is that the technologies are all so different, the question of interface would vary widely. GPS interfaces would be different from robotic or sonification units, etc.
13	From a physically disabled standpoint we only need easy access to keyboard and mouse connections and protocols.
14	Should comply with the principles of universal design. Needs to be forward looking rather than just addressing current problems. It should be written in a manner that allows all manufacturers to integrate into it rather than having to change to the dominant market leaders peculiarities.
15	Physical and electrical plug and some basis of protocols.
16	The standards should cover operation of the devices.
17	You would need to cover both basic text input as well as environment navigation. To do a good job, you really need to have knowledge of and specialization for the particular ICT you are trying to control.
18	a. Type of modality (vision, speech/sound, touch/haptics) b. Interface equipment (e.g. keyboard vs. standard mouse vs. vibrotactile mouse vs. speech, etc.).

19	I have given very little thought to this and will reflect further. Initial thoughts are: Input, e.g. keypad on microwave oven. Enabling people with disabilities to control the device using a specific assistive technology solution. Output, e.g. display on microwave oven. Enabling people unable to access the display (print impaired) to "read" information on the device. This will include status information, e.g. if your microwave oven is downloading a recipe from the web.
20	Ideally all the interfaces of an ICT product should be made available to the assistive device, but in practice some high bandwidth interfaces may not. Interfaces cover both input and output - generally the output has the greater bandwidth, especially if input is merely for control. For example for a TV, with an assistive remote control, the volume control and channel hopping is available to the remote, but also subtitles should be available if there is bandwidth. However, one would not expect the full audio to be available, and certainly not the full video. With a mobile phone, as another example, the keypad input should be extended so the user of the remote device can dial numbers, e.g. by speech recognition. Text messages should be carried in either direction, so they can be sent and received on the assistive device. If there is bandwidth (as on Bluetooth), the speech should also be available, both outgoing and incoming. The features should be sufficient to cover an assistive device withdrawing electronic cash from an ATM. So there needs to be privacy and security considerations, especially since other people in the vicinity may also have assistive devices. The features should allow one too many links and many to one links, e.g. an ICT product with many assistive devices able to control it, or a single assistive device able to control a number of ICT products.
21	Messaging.
22	Whenever there is a possibility of developing a standard to promote both the interests of the consumer and the manufacturer, then the standard could cover fitness-for-use, as well as all the usual safety issues. To provide a very loose parallel example, the medical profession typically seeks to reach a consensus that a particular surgical procedure is the preferred way of treating a particular surgical need. They do not say that the identified surgical procedure is the best or only one for an individual but a balanced consensus exists based on published material etc. They certainly do not prescribe standards. If a method of identifying "the best features" were used in product design, then a consensus might be sought and reached for "best practice" similar to "best surgical practice". Kite marks could be awarded to companies in recognition of their good product design. Just as there is an "Investors in People Award" for companies, there could also be "Investors in Inclusive Product Design Award". Norms for good practice might be set. For instance, there is plenty of data on hand strength so it is possible to foresee the possibility of a product award, "Can be opened by a person with 50 % of normal hand strength".
23	Voice recognition features as well as virtual vision/assistive reading – for blind users/poor vision/technophobes (elders?). Web accessibility guidelines and requirements for all public services websites, public information, libraries and online databases, distance learning courses, computers and wireless devices.
24	Extended keyboards, single-switch operation, magnified screens, voice synthesis, voice recognition
25	For all, location and configuration of control keys, keys should give tactile click when pressed, NO touch screen, universal accessibility for sensory impairment = customizable displays (e.g., with user defined setup parameters on a smart card). If low vision, optimum print size for a given working distance, contrast polarity, colour contrast enhancement, screen luminance, field locator features (e.g., should active field be central on screen, control keys for jumping from field to field), font type, letter spacing. If low vision and or blind, speaking rate, speaking loudness, pitch, control keys.
26	I am not updated enough to answer that question.
27	I think that this depends very much on the type of assistive device and application. It would be difficult to put everything here on the fly. I guess the most important is the communication protocol.
28	I think in generic terms the standard should cover the ability to get and set attributes for objects. Where objects could be a button, screen or anything else. Without specific examples I cannot ascertain if the simple set and get will solve the problem. My only worry is that if there needs to be an event mechanism, for example the phone ringing, but this should not be difficult to incorporate.
29	One or two interfaces should be chosen and those interfaces need to be standardized. The BrailleNote is a device which has an infra-red interface. However, I believe that a standard for an infra-red interface does not exist. A USB interface would be another good choice because the consumer would only need to carry one cable which would work with all systems.
30	My second paragraph earlier is the only general example that comes to mind.
31	From your recent publications, you have highlighted the significant features. e.g. button shapes, positions and typefaces. I would also suggest the standardisation of audio signal feedback. For example, a short quick beep is used to indicate success or a no-error situation whereas a long beep would indicate an error. There may also be the opportunity to define the frequency of a beep or the relative frequency. For example, an increasing frequency indicates a higher number is selected, and the audio feedback decrease in frequency as lower numbers are selected.
32	On the one hand it should be at a hardware level, but it would also be useful to see harmony at a user interface level, with switches/symbols essentially meaning the same thing, etc.

33	Any standards should pertain to higher-level interface and functional protocols. The needs of different end-users should be considered, and related to the scope of assistive device functionality they require. It should allow a broad scope of functionality to be supported and not limited by the requirement of being "standard". We would have to ask questions such as: is it to be a standard for blind and partially sighted assistive devices taken together? Will it include deaf, and deaf-blind or interface devices for physically disabled users and so on? Should we have a family of standards in fact? As an example, blind and partially sighted end users of a hand-held device including a display showing graphical information might be required by such standards to output the display data alongside textual representations of: selected items, the whole display, the user's context in a control hierarchy (where-am-I?), and help information as requested to an attached assistive device. Depending on its own functionality, an attached device may then be able to speak or Braille the textual information yet also magnify the display.
34	The standard would need to be generic and cover all foreseeable ICT applications. We would need to understand the range of interactive objects that are exchanged between applications and user interfaces - e.g. command objects, data request objects, data objects. If we define a method/protocol for this exchange then it becomes hardware independent. Obviously some data objects would be useless to some disabilities so part of the standard must be the potential for the application to request what are the capabilities of the User Interface (UI) - or the UI must ignore those data objects and/or request the appropriate data object. This concept is an advancement to "personal accessory" proposed by Dr Neil Scott on the Archimedes project at Stanford (?) - although without the reliance on any specific hardware protocol convertors. I imagine that initially it will be a SW "class" library type structure that may call upon any of the available communications services to "talk" to the user's interface.
35	Data and voice.

3) Should the standard protocols be independent of the transmission system (e.g. infra-red, Bluetooth, hard wire connection)?

1	Though USB has been around for 4 years and Keytools has plenty of interfacing available, I doubt if we have actually supplied more than 20, out of a possible 10 000 units shipped in that period. I think IR and BT will be very slow to reach significant levels.
2	Hard wire is still more reliable when you are not able to see, but connecting devices should be small, Flat Type RS232 connection would be more than capable.
3	This is beyond my expertise. I know of no good reason for an interface protocol to depend on the transmission method, but I just do not know.
4	Yes.
5	Definitely not. The interface standard needs to exist in the input/output data domain, not in the domain that is used for the data transmission.
6	YES! With a common "look and feel" to these things, even when using different interconnection mechanisms, it should make it less daunting, and thus more attractive to the average user.
7	Should the standard protocols be independent of the transmission system (e.g. infra-red, Bluetooth, hard wire connection)? Yes they should be independent.
8	No, tying into such technology will allow for compatibility with more inaccessible products.
9	Yes, the actual hardware protocols should be completely independent of the actual data being sent between the assistive device and the ICT. However, this communications hardware/software should provide adequate error information to the ICT and Assistive Device that the user can figure out what is happening should communications break down.
10	Yes, if possible. This not only provides flexibility, but also redundancy. (If the RF environment is too noisy to work reliably, I know I can always pull up the ICT and use my infrared port instead).
11	Independent - folks in the two categories you noted are likely to be poor and to have access to low quality and obsolete equipment.
12	I have no idea. Some of the inventors might be able to address this.
13	Yes.
14	Yes the protocols should be robust enough to cover a variety of transmission systems and should not be created to only work with new systems. A lot of people will not be able to buy new equipment and will want their existing gear to continue to be viable.
15	Yes.
16	It would be better if the protocols were independent of the transmission system in use
17	Of course.
18	Yes; otherwise one has to learn a different interface for each transmission type.
19	I think so. However, I do not know if the transmission systems have their own standards for protocols. If they do, it may be expedient to follow them and bring the industry with us rather than pushing against it
20	Yes. But note that the higher the bandwidth, the more modalities need to be covered.
21	Yes. The items communicating do not need to know what the transmission system is for this to work.
22	We should take care not to try to spot the "winners" when technology is rapidly developing – we might chose the wrong one. The worst case scenario is a standard that backed the wrong technology/protocol. In the area I am working in at the moment (barcodes for supermarket products), there are no standards yet each day, millions of products are moved from warehouses to supermarket shelves and then to homes. In the absence of standards, there are published guidelines which a company ignores at its peril. Somehow (and it will be a difficult process), I would like to see best practices guidelines used by product manufacturers so that a company can say, "We are working at the recognized highest level of product development for inclusive design". The company will want to work at that level for both increased product sales and external recognition.
23	Definitely yes!
24	Yes, it should be an independent communications layer, adaptable to any current or future transmission system.
25	Yes, but they need to be adjusted for expected working distance and screen size
26	Yes if possible.
27	Ideally yes. If the protocols are independent of the hardware (level below) everything will work finer. I would be a very good success if it is possible to create a protocol independent of the hardware. The only problem is the cost of the final system.
28	Should the standard protocols be independent of the transmission system (e.g. infra-red, Bluetooth, hard wire connection)? This is good protocol design and will happen. However what is important are the media factors of wireless versus hardwire. Extra intelligence is required to make or re-establish wireless connections securely where as the hardwire it is simpler.
29	No opinion.
30	Not exclusively for disabled people. Only if impelled by mass-market considerations. I also find the question somewhat unclear (but put this comment after my answer! ah, well...)

31	Ideally the standard should be independent of the application, for two reasons. Firstly, the user should not need to be aware of the underlying technology and secondly, the standard will endure changes in the technology.
32	Yes, I would have thought so.
33	Ideally, yes. The control and data transmission systems could be assigned to lower interface levels in a hierarchical interface model. However, the requirements of the overlaying assistive interface protocol must be serviced. For instance, such things as the rates of transmission and type of data passed could limit the functionality supported; screen enlargement over a slow serial link to a special monitor may not work very well. They need then not be defined, but their requirements need be specified.
34	Most definitely. For maximum flexibility the standard must only define a logical structure for the control/interrogation and data transfer aspects of the interface. The implementation for this may be in software, firmware, hardware or combination. The market place will determine which transmission system will evolve to be most useful for this purpose.
35	Yes if possible

4) What other aspects should be considered when preparing this standard?

1	I realise I am sounding dismissive. I do not intend to be and so my suggestions are: a) That manufacturers are reminded of their obligations to be helpful to those with disabilities in the first place, (and that there are commercial opportunities too!) b) That black-box interfaces are encouraged, so that legacy equipment can be used (e.g. serial to USB converter mice port). Many useful assistive devices are stuck in a time warp, and will be for some time. 486 machines still offer value in some situations. c) Related to this, manufacturers should be encouraged to make a simple real-world interface and place this in the public domain. An example is the mobile phone. Unless your hands are dextrous, your eyesight good and hearing acute, you are struggling. If a specialized supplier such as ourselves wanted to assist with, say a larger plug-in keyboard, we cannot get into the device. It would be relatively simple - and free - to supply a real-word interface that would allow such third-party devices to be made available - if there were a will to do so in the first place. So mainstream suppliers do not just guess what might be useful, but should be encouraged to employ organizations such as yours and mine to advise on real products that would really help. d) A key issue that we hit time and time again (10 years and still going strong) is that every gadget, keyboard, and software package needs an able-bodied person hovering in the wings to help. In the simplest case, which we have actively promoted all this time, the assistive gadget plugs in (Plug-in-and-go) no software is needed. Then all it requires is dexterity (to aim the plug) and eye-sight (to see the socket). Even mum (!) can manage that. When we reach the dizzy heights of software loaders form CD-ROM, fiddling with the control panel settings, downloading new drivers from the internet, then more sophisticated helpers are needed. (And are just not available from social services yet!) If blue-tooth were truly able to deliver total automation - no external help needed then great. e) I actually think the answer is blue-tooth. The others are just staging-posts. However, we could wait 5 years for BT to be of any significance, 10 for it to be as significant as even serial connection is today, and 15 for it to be the dominant issue for assistive technology. f) Then we can dream the fine dream. Picture a robot dog - Bluey. Its owner is mostly blind, but lives alone and is fiercely independent. Once set-up, Bluey will respond to only to its owner's voice, and retrieve messages to relay to its master. It re-programs itself from the internet. It will communicate (blue-tooth) with the cooker to tell the owner that the pan is boiling; with the front door, to let someone in (via their Bluetooth security card); with e-mail to retrieve and speak messages to the owner, to say that the freezer has stooped working, that it is got three quotes for the repair, and should it select the cheapest, and that the central heating is now due for a regular maintenance, and the man can come next week. The woman in the apartment next door has a blue-tooth cat. She is wheel-chair bound, not blind, and her cat includes a mouse (!) and keypad. It allows full computer access, as well as remote control to all functions of the house. Next door but two, the disabled 8-year old girl has fluffy bear..
2	Interface problems between devices.
3	This is not an easy thing to do. It needs to be good enough for today's needs, expandable for the future, and it needs the support of industry if it is really to be accomplished.
4	Software variations such as PC vs Macintosh OS, different versions of OS, different versions of web browsers, need for and problems with constant software upgrading, also, on-site services to users for installing upgrades, configuring them and training the users.
5	Simplicity!
6	Plugging things in, installing software etc. can be quite worrying to beginners, especially those who are disabled. I think the overall aim should be to ensure ease of use to the end user, even if that makes it more complicated at the developers end.
7	*No answer*
8	a. What developments could affect the greatest amount of enhancements for the greatest number of groups of disabled persons. b. This technology will always be accompanied with a certain amount of hand-holding and support. Typically, a distribution network accomplishes this goal.
9	The ICT, when being used via a remote assistive device, should expect delays in response, and not automatically shut-down or leave a selected option if it takes a long time for the person to respond. If, after some time, nothing is received after a function such as "Make a Call" has been selected, then the ICT should "ping" the assistive device to make sure it is still there, and request an update. If the assistive device responds with the same selection and a "wait" code, then the ICT should continue waiting for the phone number for another extended period of time. Also, especially if you are using Bluetooth, you will want to consider privacy issues and encryption of the communications between the assistive device and the ICT.
10	I believe the need for two-way communication of the user interface with the device is essential. The designers of the ICT will know best how it should be presented on the screen of a PDA, described audibly, etc. The protocol should account for some sort of hand shaking between the ICT and AT equipment like this: ICT: "I am here" AT: "OK. What do you do, and what does your user interface look like?" ICT: "I am an ATM machine, here is a list of the commands that I accept, and here is the graphics and audio files of my user interface" AT: "The user has initiated this command..."

11	Usability by individuals with other print impairments, such as persons with specific learning disabilities
12	Again, over my head, but the inventors list might help. They can also point you to other lists with sophisticated consumers.
13	There is no such thing as a typical disability in the physically disabled marketplace as compared to the visual and blindness fields.
14	Is this standard going to be specific to one country or a global? How will it work with products being produced from diverse parts of the world but being used in other countries?
15	The simplicity of use for not expert people.
16	Unable to comment further on this until I have had time to research the area.
17	Extreme extensibility.
18	a. User-friendliness b. Cost c. universality of access across software platforms
19	Further reflection required.
20	What other aspects should be considered when preparing this standard? The AIAP protocol has been developed to allow a negotiation between the product and an assistive device, to customize the interface appropriate to the capabilities of the user. I am not sure this is necessary. I think that the protocol should allow the extension of all input and output interfaces to the assistive device, and the device and/or transmission system will reject those interfaces it cannot handle. A smart assistive device may present the user with interfaces according to the user's situation: e.g. vibrating alarm in the concert hall, but acoustic alarm in the bedroom (to wake up). I also take a user-centric view of control. The user decides on the product to be controlled and the user initiates the protocol via the assistive device. However, there is a case for allowing a product to announce its presence, e.g. when the user walks into a room with a TV, or as the user walks past an ATM.
21	Existing and future planned standards should be considered. There is current work for protocols for household devices/appliances to communicate, among other things, which could possibly just be expanded upon.
22	As you can tell, I am a little wary about standards. However, just as television adverts sell a soap because it is "gentle on your skin" (whatever that means), could we aim for a product kite mark that says, "developed, manufactured and sold to meet inclusive design requirements". It would be a challenging task to define what is meant by " ... to meet inclusive design requirements", but no more difficult than to define a soap that is "gentle on your skin".
23	Systematic consulting and simulation with mixed users regarding age, sex, literacy, type and intensity of disability AS WELL AS with: a) researchers from various domains (not only ICT or disabilities areas) such as neuro-physiology, psychology, sociology, education, applied social sciences; b) previous existing services, systems and equipments which are already provided and fit for disabled users.
24	Probably a unified model of a basic human interface to extract a basic layer of user interaction.
25	*No answer*
26	I am not updated enough to answer that question.
27	What other aspects should be considered when preparing this standard? I think that the aspects that should be covered are the requirements of different applications and is important to try to include all possible applications under the same standard.
28	I do not think we should prepare a standard but instead search for a standard or adapt an existing standard into achieving the final goals. Also we should search for a standard that is widely adopted and has been tested and used extensively in industry and consumer products. Finally, if at all possible if the standard is maintained by Open Source Foundation which will mean that it is free and secondly contributed to by the best brains in the world. Examples of such standards are : SNMP - (Simple Network Management Protoco)l, which views everything as a file structure and sets and gets attributes. OBEX - (OBject EXchange), which views the world as a set of objects and gets and sets attributes. Obex is supported by most mobile phones and is used by the Bluetooth SIG, but is only used for data exchanges, while AT-commands are used for telephony. Although not in the earlier category the Bluetooth SIG are doing Human Interface Device (HID) profile. Where Phones can be controlled remotely across a Bluetooth link. However, this is a closed group so I do not have access to what it involves.
29	Ideally, all communication between ICT devices/systems and assistive devices would be accomplished through one standardized interface and that interface would either be blue tooth or infra-red because there would be no cable that the person who is using the assistive device would need to carry or connect. If there were such an interface, someone using an assistive device would then be assured that he/she could successfully communicate with all ICT devices/systems.
30	Since I think a "separate standard" is neither useful nor desirable, I have no aspects to recommend for consideration. However, for others who may differ, provision of a categorical list of such aspects (by you), which recipients may consider and respond to, might result in more useful response.
31	It appears you are already addressing the main issue – international co-operation. If these are to become standards, who is the regulatory authority?
32	*No answer*

33	Cost of the solution should obviously be weighed against future savings once such interface standards have matured and are widely used. I have touched on this one in 3, but responsiveness is another factor, which I think from our own experience is often not given due weight. It is possible for an interface to introduce system latency, which is frustrating not only for the end user but also for assistive technology designers dealing with a latency problem. If it arises from an interface they have to use, it is difficult to do anything about it. So, a standard can help circumvent the problem by requiring fast interface responses.
34	*No answer*
35	Current standards and practices used in industry and with Assistive Technology.

Annex C: Bibliography

- ISO 9999: "Technical aids for persons with disabilities - Classification and terminology"

History

Document history		
V1.1.1	January 2004	Publication