

**Standardisation Requirements for**  
**Access to**  
**Digital TV and Interactive Services by**  
**Disabled People**



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**Interim Report to CENELEC  
on  
TV for All**

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From the “Mandate to the European Standards Bodies for Standardisation in the field of information and communications technologies (ICT) for disabled and elderly people. M/273.”

***“The provision of technology-based solutions for integrating disabled and elderly people and helping them to lead full and independent lives requires two complementary approaches; the "design for all" approach and the “assistive technology approach.”***

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## Introduction

The EU has set the achievement of gaining “widespread access by all citizens to new services and applications of the Information Society as one of its major goals for the coming decade.” There can be no doubt that Digital Television can play a fundamental role here. Yet to achieve “widespread access by all” its usability from the outset will need to be based on good design principles. Failure to do so will result in disabled people, some 20% of European Society, being excluded from the essential ingredients of information, entertainment, culture, public discussion and debate.

Today, there are more than 70 million people aged 60 and above in the EU, representing just under one in five of the population. According to Eurostat<sup>1</sup>, over the next fifteen years, the population aged 65 and over will increase by 22%. During this period the number of people aged 80 and over will rise by almost 50%. Many of these citizens will experience dexterity, cognitive, hearing and sight problems in later life.

By example, a report by Professor Adrian Davis, from the Institute of Hearing Research (IHR), indicates that an estimated 81,536,000 adults will have a hearing loss in Europe as a whole by 2005. By 2015 the figure will be 90,588,000<sup>2</sup>. This means that more than one in seven adults in Europe will have hearing problems. Some 7.4 million people who are already suffering incurable sight loss further is set to increase the number of European citizens experiencing some form of sensory impairment.

If these people are to be attracted to Digital Television then the importance of assistive services cannot be underestimated. As well as deaf and hard of hearing people gaining from subtitling there are those learning a second language or watching a programme in a second language in which they are not fluent. People with learning disabilities and children starting to read<sup>3</sup> also benefit. Hearing people can find subtitles convenient in their daily lives, for example, when there is high background noise in their domestic environment. It follows that by increasing the amount of subtitling on television broadcasters are providing an improved service for the vast majority of their viewers. Audio description too can provide a vital service for blind and partially sighted people. A notable comment by a viewer during the in the AUDETEL trial<sup>4</sup> is indicative of how people’s lives may be transformed. *“Normally after the first ten minutes of a film I give up. Without the description I wouldn’t have been able to watch it”*.

The availability of sign language can also play an important role, especially on children’s television for deaf children who are too young to read the subtitles.

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<sup>1</sup> “The social situation in the European Union 2001 (Eurostat)”.

<sup>2</sup> The 81.536 million figure is for people aged 18 and over with bilateral hearing impairment at 25 dB Hearing Level and above both in EU member states and other European countries (as defined by UN/WHO).

<sup>3</sup> See Deborah Lineberger, University of Kansas (2001) *“Learning to Read from Television: The Effects of Using Captions and Narration”*, in: Journal of Educational Psychology 2001, Vol.93. No. 2, pg 288-298 and Andrea Shettle, Gallaudet University (August 1996), *“Closed Captions: An Untapped Resource in Combating Illiteracy”* taken from [www.robson.org/gary/captioning/shettle.html](http://www.robson.org/gary/captioning/shettle.html)

<sup>4</sup> The AUDETEL project Audience Reaction Final Report 1995 Chapter 5.4.4.2 page 55

With an increasingly ageing population it is an unfortunate fact that many people will face problems of dexterity and lose their cognitive powers. Elderly people, however, must be part of the Information Society; it is therefore imperative that Digital TV equipment and the basic broadcast services are easy to use and access.

Europe, in recent years, has seen some encouraging signs towards the inclusion of disabled people within society. Not least of these has been the eEurope 2005 Action Plan<sup>5</sup> aiming to accelerate the Information Society and two important EC Directives: the Framework Directive 2002/21/EC<sup>6</sup> and the Universal Service Directive 2002/22/EC<sup>7</sup>. Arising from these directives already a number of initiatives are already in place. In particular one of these was the Workshop "TV Broadcasting for All" organised by CEN, CENELEC and ETSI in Seville on 13-14 June 2002. A conclusion of this Workshop was to set up a Virtual Working Group to look at particular standardisation requirements in order to further access to Digital TV and interactive services by disabled people. This interim report under voucher CENELEC/ENTR/e-Europe/2002-0497 describes to the work of the virtual group to date and outlines the path towards standardising and identifying users' requirements.

Indications are that the path towards standardisation may not be easy because from the initial exchange of thoughts it became clear that the individual bodies: broadcasters, consumers and manufacturers held differing views on what may be practicable. Nonetheless at a follow up meeting in September 2002 at CENELEC headquarters in Brussels it was considered that by addressing many issues early in the design stage, using Design for All<sup>8</sup> principles, rather than later when production had commenced, then little or no extra cost might be incurred. It was also recognised that the introduction of Digital TV offers manufacturers and broadcasters an opportunity to introduce new products and services and for the consumer to consider how to make best use of them.

Apart from value to society by addressing such humanitarian issues there are clear economic benefits to attracting the many millions with disabilities to the use of Digital TV and Interactivity. Few would disagree with this premise, yet evidence already exists to show that the process must begin now before the opportunity is lost. This evidence comes from the UK where over 40% of households now have access to digital TV<sup>9</sup>. The same source revealed that the path to this new technology is not easy for all. A recent report by the UK's Independent Television Commission and the Consumers Association, "Easy TV Report"<sup>10</sup>, found that when comparing analogue TV to Digital TV some people perceived it as difficult to use as a Personal Computer. The message is clear; in the words of the report "the potential benefits that Digital TV can bring to those sections of society who currently lack access are unlikely to be realised if Digital TV equipment and services are not easy to use, and perceived as such. Furthermore, low ease of use – or even perceptions of

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<sup>5</sup> eEurope Action Plan

<sup>6</sup> The Framework Directive 2002/21/EC

<sup>7</sup> The Universal Service Directive 2002/22/EC

<sup>8</sup> Design for All ICTSB 15.05.2000

<sup>9</sup> Independent Television Commission News Release 19/03 published 19/03/2003

<sup>10</sup> Independent Television Commission and Consumers Association "Easy TV 2002 Research Report", 7<sup>th</sup> January 2003, page 2

low ease of use, might constitute a significant barrier to the take-up of Digital TV by some members of the public.” There is no doubt then that as stated in CEN/CENELEC Guide 6 Guidelines for Standards<sup>11</sup> “that standardisation greatly influences the design of products and services that are of interest to the consumer and therefore can play an important role in this field”. The debate now is where standardisation should be applied and to what degree. To that end the intent of this interim report is to stimulate discussion especially by broadcasters and manufacturers as to what may be practicable.

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<sup>11</sup> CEN/CENELEC Guide 6 Guidelines for standards developers to address the needs of older persons and persons with disabilities Edition 1/January 2002 Section 4.2 page 3

## 1. Executive summary

**TV for All Group.** The TV for All group comprises representatives from a variety of organisations which have an interest in furthering access to Digital TV by disabled people. By forming such a group the expectation is that manufacturers, broadcasters and representatives of disabled audiences can become involved in a unique exchange of views in identifying what standards are needed to enable easy access to DTV to the benefit of all. To date input from delegates to the conference has been limited but it is hoped that this report will encourage broadcasters and manufacturers in particular to come forward with comment. This first report therefore details the initial work of the group towards that end, its progress to date and attempts to identify the main areas where barriers to access might occur. It is already becoming clear that while much can be achieved through standardisation the introduction of codes of best practice and general agreement between providers, producers and consumers will also bring improvements. Additionally, if many of the elements noted in this report can be considered within the design stage of DTV equipment and provision of its services then there is little doubt that society as a whole will benefit. Overall recommendations towards standardisation and guidelines are given in Section 15 and those specific to CENELEC in Section 16. A full list of recommendations will be considered and detailed in the final report.

**TV for All Roadmap.** In January 2003 a road map was constructed and placed on the CENELEC website ([www.cenelec.org](http://www.cenelec.org)). The intent of this was to invite comment on all these areas which might become key to standardisation.

**Assistive Services.** It is generally acknowledged that digital television is able to improve upon the main forms of assistive services for disabled people: subtitling, signing and audio description. The shape of that assistance, however, embraces more than just the provision of services. Learning from the analogue experience the whole mechanism of Digital TV must become involved; that is: the transport of services, decoding at the terminal, use of the terminal itself and the display.

**Analogue Assistive Services.** While digital television remains in its embryo stages many people still rely upon analogue services as the main form of television, even though its limited bandwidth causes some restrictions. Some of the assistive services mentioned above are available on analogue channels although in some countries not to the extent that many would wish, even though the mechanisms for providing them are well established.

**Transmission of Assistive Services on Analogue and DTV.** A prime example of such a mechanism is the ITU-R (CCIR) Teletext System B format which can carry "closed subtitling". Although generally regarded as a rugged system, special care is needed to avoid intersymbol interference which can disrupt subtitling captions. It is recommended that a code of practice is adopted for aerial installation procedures. Audio description on a separate sound channel is also possible and now available in some countries. Signing on analogue however is limited to just a few specialist programmes. Now, with the development and introduction of DTV, the two former services are more

easily carried. By example a means of carrying a subtitling service has evolved through the ETS 300 743 using MPEG2 as described in the DTG 'D Book'<sup>12</sup>. The ability of DTV to carry more sound channels eases the path for audio description especially on satellite channels due the increased bandwidth. For Digital Terrestrial Television (DTT) services a special form of audio description carriage has already been developed and tested. Digital transmission also introduces the possibility of a closed signing service through the use of Avatars being conveyed at a very low bit rate. Finally there is the prospect that digital interactivity can become an essential service to house bound disabled people.

**Guidelines for Content Best Practice.** Guidelines for the construction of assistive services already exist in the analogue form and can easily translate into DTV. The UK's ITC guidelines for subtitling, signing and audio description are suggested as a minimum form of best practice together with the views of such organisations as the FDPDA, RNIB, RNID, Hearing Concern and the Subtitulado E para personas sordas y personas con discapacidad auditiva soon to be published.

**Central Register of Programmes with Assistive Services.** A reduction in the cost of assistive service production may be achieved through exchanging programme material that has already been subtitled or audio described in the main European languages. It is suggested that the European Broadcasting Union (EBU) or similar organisation acts as a central base for compiling a file register for use across Europe.

**Equipment - ease of use.** There can be little progress towards access without easy use of the equipment to receive these services. The EU report "Barriers to widespread access to new services and applications...."<sup>13</sup> states that "digital television may ultimately rival the PC/Internet paradigm for access to Information Society services once digital TV is widely implemented in the EU".

If the use of DTV to the community really is to be realised then is imperative that all receiver functions and facilities together with their remote controls must be designed with ease of access in mind. By example all control functions such as switches, knobs, and dials should be clearly labelled. Their order of importance and their location should be also logical. They should be user friendly and easy to operate. It is suggested that manufacturers and service providers included inputs from disabled viewers in the design phases of new products and services. Standards are needed for common labels and symbols on receivers and terminals

**Receiver Connections.** Because the receiver or decoder is no longer considered as a stand-alone device its connection to peripheral equipment needs to be simple and include outputs to headphones and etc. Special attention should be paid to minimising the number of sockets and cables. Even when simplified these must be clearly marked and accessible. A

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<sup>12</sup> DTG "D" Book V 3.2 February 2001 section 5

<sup>13</sup> EU report "Barriers to widespread access to new services and applications of the information society through open platforms in digital television and third generation mobile communications. 2003 Section 2.1 page 7.

suggestion is to collaborate with the UK Digital TV Action Group who are drawing up guidelines in this area.

**Future Proofing.** In terms of the receiver market as a whole – it should not follow the example of the computer industry where year on year older models are replaced by bigger and better versions. All consumers, and especially those with less disposable income, would welcome a decoder and receiver that is “future proofed”. With DTV this may well be achieved through software down loads or additional devices added to the main equipment using Common Interface or similar sockets.

**Remote Controls.** Few if any receivers today operate without the use of a remote control. Yet it is these devices that come in for most criticism. To be wholly useful their buttons must conform to some very basic and obvious considerations such as size, shape, labeling and clarity. The introduction of tactile indicators should be considered. A fundamental need is that of a single (programmable/customisable) button giving access to the most commonly used functions. There can be no better example of this as a basic requisite than a single subtitling button. The selection of subtitles should be retained after channel changing. (A suggestion is that button settings of this type ought to be able to be freely determined i.e. customised by individual users.) Assistive services once selected should remain selected on channels changes etc.

**Minimum receiver requirements and conformance.** The receivers themselves should have the capability of receiving the main assistive services and certainly have the option to continue displaying subtitles while other text or graphics are on screen. It is suggested that a conformance centre for DTV equipment is established whereby all assistive service decoding and presentation displays are tested for a minimum compliance. Compliance with this would allow equipment to display an accreditation at the point of sale, thus ensuring that consumers are purchasing equipment appropriate to their needs.

**Interoperability.** The contentious subject of interoperability was given considerable treatment in the recent report to CENELEC “Standardisation in digital interactive television” and its particular reference to MHP<sup>14</sup>. It is of vital importance that any such emerging technology should not move in a direction that will alienate disabled people wishing to use DTV. As for the purchase of the decoders, this special but sizeable group of European society should not need to purchase several set top boxes in order to access services on different platforms. The representative organisations within the group have therefore endorsed the need for Open Standards.

### **Interactive television access**

Interactivity via DTV will be important to housebound as such disabled people should not be disenfranchised from access to these services.

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<sup>14</sup> Standardisation in digital interactive television Strategy and recommendations for a standardisation policy supporting the effective implementation of the Framework Directive 2002/21/EC and the establishment of required interoperability levels in digital interactive television Final version April 2003 Page 5.

The display of a standard TV screen however is inferior to that of an SVGA monitor as used with Personal Computers. The resulting “on screen” presentation therefore can have severe limitations particularly for blind and partially sighted people. It is recommended that European guidelines are drawn up to ensure all official websites can be viewed on a television screen.

**On-Screen Information.** There can be no doubt that for blind and partially sighted people full access to DTV is dependent on on-screen information. It follows then that flexible, adaptable interfaces must be available to suit individual needs. For example all text must be clear and adapt to such simple factors as size of text and use of colours all placed within a defined “safe” area. It has been suggested that if digital TV information is to be able to transfer to other convergent media and screen sizes, then these factors should be considered during production.

**Electronic Program Guides.** (EPG’s) and menus are seen as the gateway to digital services and they too must follow the principle of being logical and intuitive. A common request is that EPG’s and similar programme listings such as “Now and Next” should indicate the presence of subtitling, signing and audio description. These indications should be either in text form or by a commonly agreed symbol.

**Recording.** Currently, due to limitations in the bandwidth used by VHS VCRs, the recording of teletext subtitling is limited to S-VHS recorders or through the use of specialist teletext decoding devices. Standard VHS machines to some degree are able to record DTV but only the channel selected by the set top box – they have no independent decoding ability. Digital recorders may enter the market, although current indications that few if any manufacturers are considering production. Of more importance is likely to be the Personal Video Recorder (PVR) where use of meta data accompanying the broadcasts may allow viewers to arrange their own schedule and set preferences. As with other DTV equipment it is imperative that the design of DTV recorders and Personal Video Recorders must incorporate use of assistive services. The technical capabilities made available by PVR’s is certainly promising and it is suggested they should be investigated for further potential in relation to adapting Digital TV for special needs.

**Promotion of Assistive Services.** Evidence exists that while assistive services may be made available, some sections of the community are either unaware of them or do not know how to access them. Broadcasters, representative agencies and National Regulatory Authorities can make significant contributions here by promoting the availability of services themselves or by giving encouragement to others. An ideal opportunity presents itself at the commencement of programmes by displaying standardised symbols for subtitling and audio description. Programme listings in magazines and newspapers should be actively encouraged by NRA’s and similar agencies to use symbols to indicate whether the services are available.

**Future Technology.** Finally, with the rapid advancement of technology in DTV there are encouraging signs that access to assistive services might be made easier. WGBH-TV Boston has created a National Centre for Accessible Media, called NCAM. One such NCAM project involves “talking EPG’s for blind and partially sighted people”<sup>15</sup>. The progress towards a SAMBITS<sup>16</sup> multi-modal receiver is also worth marking. This project aims to develop a terminal built that will allow individuals with hearing impairment, speech impairment and/or visual impairment to take full advantage of the broadcasts on Internet as well as DTV. Input to the report has suggested that Europe might do well to use the above NCAM example to establish a research centre of this type based on European needs and digital infrastructure.

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<sup>15</sup> <http://ncam.wgbh.org/convergence/barriers.html>

<sup>16</sup> [http://www.irt.de/sambits/documents/ibc\\_SAMBITS\\_overview.pdf](http://www.irt.de/sambits/documents/ibc_SAMBITS_overview.pdf)

## **2. Progress to date**

Before considering what form standardisation may take, it was imperative that the views of the organisations representing disabled people across Europe were sought. Equally, from the manufacturers standpoint, contributions were requested of EICTA; and through the EBU the broadcasters were asked to contribute. To aid this and stimulate an exchange of views between stakeholders a Road Map was drawn up and in January 2003 placed on the CENELEC website in an area designated for use by the TV For All group. Initially access to the website was limited to the participants of the Seville conference but was widened shortly after to include all interested parties. To date input to the Working Group is slower than anticipated, although by April 2003 a limited number of contributions were being received. It is hoped that contributions by manufacturers and broadcasters will be forthcoming and the distribution of this interim report will lead to discussion at the proposed meeting in Barcelona on 28 October. A full list of those consulted both in this interim report and the final will be placed in the annex of the final report.

### **2.1. The Road Map**

An abstract of the road map below includes the basic issues to be taken into account when addressing user requirements through standardisation procedures.

- i) Identify the main forms of assistance to disabled people that may be conveyed by broadcast means.
- ii) Consider the various ways and means in gaining access to assistive services.
- iii) Consider navigational controls particularly relating to those people with sensory impairments.
- iv) Determine best practice in service presentation techniques for both audio and visual means
- v) Create awareness by National Regulatory Authorities
- vi) Create awareness amongst those needing the services and propose measures for promotion by broadcasters and service providers.
- vii) Include proposals for future-proofing

In parallel with this initial work an extensive search was made for any existing documentation that may relate to DTV accessibility. It became clear that already a considerable amount of information and initiatives existed both within Europe and the US. Where relevant these have been considered and referred to in this report and are listed within the References section.

## **3. Main forms of assistive services on analogue and digital platforms (terrestrial, cable and satellite)**

### **3.1. Assistance on Analogue Platforms**

Without doubt the mainstay of European broadcasting is still by analogue means. (This is especially the case for those services using terrestrial and cable distribution). Where analogue remains a major form of distribution

consideration should still be given to the basic forms of assistance for sensory impaired people namely: subtitling, signing and audio description. It is noted however that these can be limited due mainly to the bandwidth occupied by the video and audio components of the signal. It is also noted that the extent of these services has substantial variations between member states. Contributors to this report have indicated that as a base line all services currently enjoyed on analogue services must as minimum be available on DTV.

### **3.1.1. Analogue Subtitling**

“Closed” captions have been derived as a special form of teletext carried in the Vertical Blanking Interval (VBI), the so-called teletext lines. The style of the font, its graphics and colours are limited. (Fuller details are given in the ITU-R (CCIR) Teletext System B issued by the EBU). Improved versions of teletext have been proposed and adopted in some countries, notably Germany, but these have not been widespread nor translated into the carriage of subtitling.

### **3.1.2. Analogue Audio Description**

The bandwidth of analogue services is restricted in that little room can be found for an additional sound channel. Both France and Germany have developed a Two-Channel Sound format which utilise one half of the stereo channels to provide AD. (See section 4.3.1) The UK’s AUDETEL<sup>17</sup> trial in the 1990’s used the innovative approach of sending the voice channel within the VBI. Additionally

### **3.1.3 Analogue Teletext Screen Reader**

Blind and partially sighted people can benefit from a screen reader which can produce an audio output of teletext pages. The device uses a text to speech engine but cannot translate graphics such as those used on a weather map.

In the Netherlands a system known as audio subtitling has become a mainstream service for all foreign language programmes on the three public TV broadcasting channels. Whilst this is not the same as audio description, in that subtitles are decoded using text to speech engine and converted into a synthesised voice, many people value the service.

### **3.1.4 Analogue Signing**

The ability to carry the image of a signing person within an analogue services is limited unless spare capacity is found for an entirely separate broadcast channel or a form of a “picture in picture”. Therefore most signing is limited to “in vision” or open signing on certain programme services. Such services are usually specifically intended for deaf people.

### **3.1.5 Current availability on Analogue Platforms**

Despite the above limitations some provision of analogue assistive services is evident across Europe and where available is much appreciated. By example, at an EBU meeting held in Antalya during 2000<sup>18</sup> attended by representatives

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<sup>17</sup> The AUDETEL project Audience Reaction Final Report 1995

<sup>18</sup> EBU Teletext Guide APRIL 2000

from 21 nations, all with one exception stated that they provided at least one of the three services: subtitling, signing or audio description. The extent of these provisions however varied in the case of subtitling from a few hours a week in some countries to other countries whose yearly quotas are set by National Regulatory Authorities and amounted to over 80% of all programmes. Some countries are now introducing legislation requiring the provision of such services, especially on Public Service Broadcasts.

### **3.2 Assistance on Digital Platforms**

Digital platforms, to include terrestrial, satellite, cable and to some extent DSL make more efficient use of bandwidth. Coupled with the packetisation of data within the Digital TV MPEG 2 bit streams this allows a variety of services which are less restricted than hitherto on analogue channels.

#### **3.2.1 Digital Subtitling**

Captions may now be varied in terms of the size of font, style and colours. High quality graphics or icons are available together with a form of transparency to the background (veiling).

#### **3.2.2 Digital Audio Description**

Several separate audio channels are possible, one of which may be used for a “closed” audio description service (although terrestrial bandwidth limitations may require a different approach – see below).

#### **3.2.3 Digital Signing**

Indications are emerging that a form of “closed” signing may become practicable either through the transmission of a human figure using low bit rates or through use of an avatar.

#### **3.2.4 Interactivity**

The extent of its usefulness to disabled people may depend on the practicality of the return channel and its availability. Cable services and proposed return paths utilising RF offer a higher bit rate than a telephone line, although to date the perceived wisdom is that the commercial benefits have yet to be realised. Access to any future services that may develop will be important to sensory impaired people and must be considered as part of the inclusive design process.

## **4. Transmission and Decoding of Assistive Services**

### **4.1 Analogue Subtitling**

Transmission. The analogue distribution of subtitles has developed through the now familiar ITU-R (CCIR) Teletext System B. File transfer between broadcasters and subtitling companies is mainly by means of the EBU File Transfer Format 3264 and it is recommended that this practice continue. In general, carriage of subtitling is achieved by use of line 335 within the Vertical

Blanking Interval (VBI) and accessed in most countries by a specially reserved teletext page such as 888.

Page numbering. Other pages are widely used prompting a view that access to subtitles should be standardised on a specific page number. There are certain advantages in this where subtitling services cross national boundaries such as satellite transmissions or in proximity to cross border terrestrial transmissions. It is recommended that the EBU and service providers consider this option where appropriate. However, where reception of services is confined to national boundaries, the expense of modifying data bridges etc may not have value. Consideration should also be given to the potential confusion caused to viewers during a changeover period.

Reception problems. Few problems exist in the transmission of analogue subtitles either by terrestrial, satellite or cable other than those of intersymbol interference caused by multipath reception. That is to say where characters or words within the captions are corrupted due to reflections or “ringing”. The problems are mainly found in terrestrial signals where signals reflected from trees, large buildings and hillsides are received in addition to the wanted signals within the incident wave. Similarly cable systems can induce reflections due to mis-terminations and inward leakage through ineffective screening. Such corruption causes considerable distress to viewers who often interpret the problem to be caused by the broadcasters. It is recommended that aerial installations should follow national good practice as exemplified for example in the Confederation of Aerial Installer’s Code of Practice for Aerial Installation<sup>19</sup> (to include CENELEC 50083 all parts). It is also recommended that broadcasters and organisations representing deaf and hard of hearing people jointly provide information on how to recognise these problems and their resolution.

## **4.2 Digital Subtitling**

DVB format. The distribution of subtitling by digital means has clear advantages not least in its resilience to interference. Clearly the extent of its use is currently limited by those countries adopting digital services. With national regulation requiring the provision of subtitling on digital terrestrial television (DTT) broadcasts, the UK has produced a draft format now known as DVB Subtitling Systems ETS 300 743 V1.2.1 (2002-04)<sup>20</sup>. With its proven track record and incorporation into DTT decoders and idTVs (integrated digital TV’s) it is recommended that this be adopted as a standard.

Authoring. To date subtitling is still authored in analogue form and if required could be mapped to DVB subtitles using the “VBI Subtitle Mapping to DVB Subtitles V.1” as drafted by the UK Digital Television Group. Mapping incoming analogue subtitles to the digital format as used by digital cable companies is also required. Further versions of this report will contain

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<sup>19</sup> Confederation of Aerial Installer’s Code of Practice for the Installation of Aerials and Receiving Equipment in the Domestic Environment 1998

<sup>20</sup> Final draft ETSI EN 300 743 V1.2.1 (2002-06) *European Standard (Telecommunications series) Digital Video Broadcasting (DVB); Subtitling systems*

reference to methods used and whether there is a recognised approach that can lead to standardisation.

### **4.3 Audio Description**

Pre and Locally Mixed Formats. To achieve audio description the narrative needs to be overlaid on the normal stereo programme sound. This can be done in one of two ways:

- i. Pre mixed. Prior to transmission the AD is pre mixed with the stereo main programme sound. The resulting composite channel is then transmitted as another full-bandwidth audio channel.
- ii. Locally mixed. Audio description is broadcast as a mono audio channel and added to the stereo programme sound in the receiver (or head end). By adding fade and pan control information to the mixing process the juncture between main sound and the descriptive passage is made less abrupt and placed under the control of the listener. The pre-mix technique is suitable where the available bit rate permits the transmission of an additional stereo sound channel.

#### **4.3.1 Analogue Audio Description**

AUDETTEL Project. Probably the most noteworthy form of analogue TV audio description trial within Europe was the abovementioned AUDETTEL project undertaken by the ITC supported by EC funding. The UK trials, 1994 -1995, using the locally mixed format, were relatively successful but there remained some concerns about the speech quality unless two or more VBI lines were used. As the end of the project coincided with the planning for Digital Television agreement reached between the RNIB and the broadcasters was that any such service would be more suited to digital transmissions which were being anticipated at the time. (Unfortunately the anticipated early adoption did not prove possible after all.) It is noted that the report "Design for All, Annexe B, Recommendations for Digital Broadcasting"<sup>21</sup> refers to AUDETTEL becoming a European wide standard. It is suggested that in the light of progress with digital audio description this should be deleted

Other Analogue AD Formats. Some EU broadcasters currently provide pre-mixed analogue Audio Description particularly in Germany and France including ZDF, Bayerische Rundfunk and Arte. Viewers using cable or terrestrial services may opt to select the AD dialogue with main sound or just the main sound channel. To date analogue satellite viewers are disadvantaged in that no such option is available, instead the two channels are be separated and heard in mono. These services utilise one half of the stereo channels to provide AD and use the pre-mixed technique described above. In the US where the video and audio consume less of the given bandwidth, use is made of the Subsidiary Audio Program (SAP).

#### **4.3.2 Digital Audio Description**

Use of MPEG 2. For satellite channels with less bandwidth constraints it is relatively easy to carry an additional sound channel. Some stations in

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<sup>21</sup> Design for All ICTSB 15.05.2000 Annexe B page 20

Germany and BSkyB in the UK are already supplying such a premixed service. DTT services however have a more limited bandwidth and as such the UK broadcasters adopted a different approach. This was to place the audio description channel as packets within the standard MPEG 2 bit stream. A full description is given in the DTG D-book v3.2 Chapter 4 (Audio System Characteristics)<sup>22</sup>. The technique includes coded fade and pan control information in the PES\_private\_data of the SI. The signalling rate is typically a few bytes per second. The receivers then make use of the pan and fade data to locally mix the mono audio description with the normal stereo programme sound channel.

The above technique could in the future potentially be used for other broadcast and non-broadcast services but is not intended to replace the use of pre-mix audio description where platforms support the bandwidth needed. Recently the ITC has asked the DVB Commercial Module to endorse the above as an editorial activity to be added as an informative annex to the DVB Implementation Guidelines (TR 101 154). It is recommended that ETSI accept this as an optional standard.

Audio Description Module. During the above development The Digital Network in the UK in conjunction with the RNIB undertook work on a decoder known as Audio Description Module (ADM). Based on many of the principles of the former AUDETEL decoder this was designed to fit in a PCMCIA or a Common Interface slot (CI) of Set Top Boxes (STB). While a limited number of prototypes became available during 2002 the necessary funding to produce a large-scale order has yet to become available.

Progress towards the integrated decoding transmission and decoding of AD can be made if the next generation of silicon fulfils the necessary requirements. Current indications are that MPEG 4 may be a suitable vehicle for AD. Also the SAMBITS (IST-1999-1205) project using MPEG 2, 4 and 7 may provide an audio channel capable of conveying audio description. It is recommended that CENELEC and ETSI closely monitor these developments before giving consideration to any standardisation.

## **4.4 Signing**

### **4.4.1 Analogue Signing**

Across Europe open signing has been available for some time but, as with open subtitling, conflicts can arise with viewing by the wider audience. Specialist programmes aimed at sign language users are also available in some countries but with the criticism that the programmes are broadcast in unsocial times of the day. Clearly it is possible to provide a dedicated channel for deaf people who need or use signing either in analogue or digital form, but it would need considerable support. One such channel in France, TVST, commenced in November 2002 carrying subtitled material but clearly it could have open signing.

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<sup>22</sup>DTG D-book v3.2 Chapter 4. (Audio System Characteristics). 1996-2002

#### **4.4.2 Digital Signing**

Low bit rate channels The option of closed signing in a compressed digital form has been considered in Germany and the UK. In order to convey closed signing within a separate channel the level of definition required is dictated by the resolution of the image; this should be sufficient enough to show all lip, face and hand movements. Current indications are that a bit rate to convey such images is around 300 kbit/s although some UK research (notable by the BBC and ITV Laboratories) indicates that lower rates may be possible. To date it is understood that there are no plans to introduce this form of service at these bit rates.

Use of Avatars. Currently a number of research projects are investigating the use of signing avatars for various applications and especially relevant here is the possibility of closed signing in television programmes. Other applications include: teaching reading to deaf children, developing sign dictionaries and siting within information kiosks and shops such as post offices.

A notable avatar project was VisiCast (<http://www.visicast.co.uk>). In An EU funded project (2000-2002) the long-term objective was to have automatic translation of teletext subtitles into animated sign language. The project demonstrated that virtual human characters could convey usable signing for television, point of sale and Internet applications. In view of this, the VisiCast project has implemented a simplified 'closed signing' system, where the image of the sign language interpreter can be turned on and off by the viewer. The advantage of the 'virtual human' signing approach is that only the positioning information required to activate the avatar in the receiver (face, body, hands) need to be transmitted, reducing the required bandwidth by up to a factor of ten compared with a video approach ( about 30kbit/s). More significantly such an approach promises to open up all programmes that have been subtitled. into sign language gestures and movements. Techniques to translate in real-time, however, from English into natural forms of signing ended in December 2002. VisiCast has since been replaced by eSIGN. This is still investigating avatar technology, but the application is aimed at the Internet. The project is within the eContent project, funded by the EU, with partners in Germany, the Netherlands and the UK who will be providing eGovernment information in on-line sign language using avatars.

It is understood that BBC Research and Development has developed its first demonstrator for broadcast closed signing based on motion capture and is planning to continue this work.

Developments in Germany. In parallel with the above initiatives the German Workgroup "Subtitling and Sign-Language" (Arbeitsgruppe Untertitel und Gebärdensprachdolmetschereinblendung") are to ask the Institut für Rundfunktechnik (IRT) to conduct research into what elements of MHP are needed to implement DVB carriage of a signing interpreter without the use of an Avatar.

The following characteristics are to be investigated:

- The ability to alter the width and height of the inlay
- Select the inlay's position on screen

- Provide options to change the background from transparency through to black and within an oval or rectangular window
- Obtain the data to form the interpreter either from a DVB bit stream or the Internet
- Consider any bandwidth reduction by use of new technologies such as DIVX-5 etc.

As with developments in the field of Audio Description it is recommended that standardisation organisations closely monitor prospects of closed signing mechanisms.

#### **4.5 Interactivity**

Generic APIs. Future access to interactivity through a common standard is no less important to disabled people than to their fellow citizens. Indeed it may be argued that ease of access is more important in that it can offer market services that may otherwise be difficult to visit in person. Yet it is noted from the report by Contest Consultancy to CENELEC on 12 March 2003 “Standardisation in digital interactive television”<sup>23</sup> that to date there has been no consensus across industry towards a generic API platform and several forms of API exist in the European market. Interoperability between platforms is clearly an issue here and many look to the EC and standardisation bodies to provide a migratory path to a common standard.

MHP. Reference to interoperability in the context of the Frame Work Directive<sup>24</sup>, the Design for All Final Report 15.05.00<sup>25</sup> and statements in the meeting held at CENELEC on 12 March 2003 indicate that MHP is still the favoured execution engine. While this is understood by representative organisations for disabled people the view is, especially in the more mature UK Digital TV market, that earlier API’s such as MHEG5 should migrate to, or co exist with MHP. This would ensure that disabled people are not denied access to new services. It is noted that such processes involve the CENELEC/EBU/ETSI Joint Technical Committee, DVB and ATSCC and they hope to resolve these issues within a short time frame.

### **5. Receiver Terminals, Peripherals and Interactive Equipment**

For the foreseeable future the television receiver with its display screen and associated audio outputs will remain the prime device for access to digital television, whether as a standalone device, such as an idTV, or by connection to peripheral equipment such as decoders, set top boxes and Personal Video Recorders (PVR’s). With very few exceptions today these are controlled by external devices: remote controls, keyboards and the mouse.

Studies into access needs. In recent years there have been a considerable number of studies into the means of use and access. It is the intention of this

<sup>23</sup> Standardisation in digital interactive television Strategy and recommendations for a standardisation policy supporting the effective implementation of the Framework Directive 2002/21/EC and the establishment of required interoperability levels in digital interactive television Final version April 2003 Page 5

<sup>24</sup> EC Framework Directive 2002/21/EC March 2002 Articles 17 and 18

<sup>25</sup> Design for All ICTSB 15.05.2000 Annexe B Section B1page 20

report to consider these and address the more practicable aspects for standardisation. Due acknowledgement is given to the most notable of these reports which are:

Information and Communications Technologies ICT Standards Board<sup>26</sup>

CPB/WGBH Access to Convergent Media Barriers to Convergent<sup>27</sup>

ITC and Consumer Association's Easy TV study<sup>28</sup>

ANEC Consumer Requirements in Standardisation relating to the Information Society<sup>29</sup>

These studies have in part or in entirety looked at the display terminals, the displayed content, means of control and access and the interconnections. This section will concentrate on receiver terminals and peripheral equipment, their controls and connections.

### **5.1. Receivers and Peripheral Equipment**

Basic Design Principles. The range of facilities now provided by receivers can be considerable; the downside however is that in turn these can lead to a proliferation of control switches and connections. For even the most competent person their functionality can cause bewilderment. This observation, endorsed by several reports, suggests that encouragement is needed for digital television equipment manufacturers and service operators to place an increasing level of importance in making the equipment and services user friendly and easier to use. Considerable progress towards realising this would be achieved if manufacturers and service providers included inputs from disabled viewers in the design phases of new products and services.

Benefits of Good Design Principles. The CEN/CENELEC Guide 6 "Guidelines for standards developers to address the needs of older persons and persons with disabilities"<sup>30</sup> and Design for All - ICTSB Project Team<sup>31</sup> are very relevant here. There is no doubt that the design factors which aid people with sensory and cognitive impairments also improve usage by more able consumers. While it might be argued that considerations may have cost penalties these can be offset if addressed early in the design stage and applied across the entire range rather than in a few specialised top of the range devices. The spin off for the manufacturer is that the product appeals to a wider consumer base. While this is an ideal concept, it can only succeed if a product's functions are easily understood and known by the consumer.

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<sup>26</sup> Communications Technologies ICT Standards Board 1999 Design for All Final Report

<sup>27</sup> CPB/WGBH Access to Convergent Media Barriers to Convergent Media for Individuals Who are Blind or Have Low Vision

<sup>28</sup> Independent Television Commission (ITC), Consumers' Association (CA) and Design Council (DC Easy TV 2002 Research Report April 2002 the Independent Television Commission (ITC), Consumers' Association (CA) and Design Council (DC

<sup>29</sup> ANEC Consumer Requirements in Standardisation relating to the Information Society January 2003 (ANEC2003/ICT/008)

<sup>30</sup> CEN/CENELEC Guide 6 "Guidelines for standards developers to address the needs of older persons and persons with disabilities" Edition 1 January 200219. Report on Standardisation in Digital Interactive Television by Contest Consultancy 4.1 v page 24

<sup>31</sup> Design for All - ICTSB Project Team Final Background Report 15.05.00

### **5.1.1 Minimum Performance Standards**

Minimum Baseline Conformance. With the main forms of assistive services being available on analogue services for many years it is not unreasonable for consumers to expect them to be available on all DTV equipment. It is therefore recommended that standardisation organisations consider the establishment of a conformance centre which would undertake testing decoders to ensure that they provide the necessary minimum functions allowing accessibility. Receivers that pass the minimum base line functions could carry a list of "accessibility standards" which are readily identified at the point of sale. In addition it is recommended that an easily recognisable symbol is devised that could be used on a label or "swing ticket" to indicate that they fulfill the minimum standards of easy access and use of control functions.

### **5.1.2 Control functions.**

All control functions and facilities including switches, knobs, and dials should be clearly labelled with serif typefaces, uniformly spaced and placed in a logical fashion. The importance and location of controls should be identified by their size (also texture or shape) the most important being larger. All control buttons etc with accompanying labels should have a line to show association. The line should be kept away from any lettering especially if it is raised to avoid tactile confusion with the lettering.

Where the above are placed behind a panel this should be made obvious to the user and marked with tactile surface indicators. It is recommended that, in conjunction with representatives of sight impaired people, an industry standard is devised in this area.

### **5.1.3 Connections**

Sockets and Connectors. External connections to peripheral devices should be easily accessible, defined by size and clearly marked. Again, if behind a panel, this should be clearly marked with tactile indicators. To enable connection to VCR's, set top boxes, DVD's and PVR's the very minimum of two SCART connectors is now a basic requisite. An audio jack socket for headphones and connection to audio loops for use with hearing aids is also fundamental for deaf and hard of people and should be mandated. An RF loop-through is desirable for connection to recording devices. The facility to connect video cameras, hi fi and other AV devices is now commonplace and should be provided again with clear markings. All services should be available via external ports to facilitate devices such as voice synthesisers and Braille printer using an industry standard e.g. XHTML.

Standardised cables and connectors should be used rather than proprietary versions. All should be marked with common and easily understandable symbols with clear information given in the accompanying manual. Any symbols used must have been tested through consumer clinics.

### **5.1.4 External Facilities**

The unit should indicate that a remote control button has been depressed; by example for example by the illumination of an LED.

Speech commands through a microphone are beginning to make an appearance within PC systems and should be considered for use within idTVs.

Audio information is especially helpful to blind and partially sighted and elderly people with dexterity problems. The following facilities if built in to receivers would be of considerable benefit:

- The option of auditory tone and visual clues to indicate incoming information and processing. Each manufacturer could offer this facility as part of the range.
- The ability to repeat any audio messages.
- An option for essential keys or buttons to “speak” when pressed should be available.

### **5.1.5 Upgrades and Future Proofing**

Confidence in digital services and especially the receivers as a long term investment would be considerably enhanced if terminals could incorporate backward compatibility and “future proofing” either by means of software down loads or simple addition of hardware. While it is noted that idTV’s are required to incorporate a Common Interface (CI) slot, consideration should also given to including them within Set Top Boxes thus extending their useful life in the event of new developments. This view is endorsed by the Report on Standardisation in Digital Interactive Television by Contest Consultancy<sup>32</sup> where it is stated standards have to be sufficiently future proof, i.e. it must be reasonably certain that they do not have to be exchanged half-way through the implementation process because they are technically or economically overtaken.”

### **5.1.6 Interconnections between TV’s, VCR’s, and PVR’s etc.**

All receiving terminals such as set top boxes will need to be linked to other devices, for example the analogue TV, VCRs and soon PVR’s. The interconnection of these devices is already too complex for many consumers and especially those who are disabled. Consideration must be given to simplifying these interconnections. The UK Digital Television Group has been working in this area for some time and has produced Connectivity Guidelines for Installers and Manufacturers. It is suggested that contact is made with the DTG to look at a joint form of standardisation. The guidelines relate to best practice for connecting digital converters and other devices to TVs and VCRs. For example there would be a value in colour coding SCART cables. Some forms of SCART connectors are prone to disconnection when moved thus causing a variety of problems. The design of the connector and its socket should be improved to avoid this.

### **5.1.7 Decoding abilities**

The most basic receiver must include ability to decode subtitling and audio description services. This much is already recognised in the US where currently the Federal Communications Commission (FCC)<sup>33</sup> are looking at ways to require all DTV’s to include a caption decoder. This may allow the

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<sup>32</sup> . Report on Standardisation in Digital Interactive Television by Contest Consultancy 4.1 v page 24  
<sup>33</sup> [http://www.fcc.gov/Bureaus/Engineering\\_Technology/News\\_Releases/1999/nret9001.html](http://www.fcc.gov/Bureaus/Engineering_Technology/News_Releases/1999/nret9001.html)

viewer to control the caption display by selecting key features such as different fonts, character sizes and colours.

Minimum decoding functions and Conformance to EC Standards. It is understood that virtually all UK DTV receivers have the capability to decode subtitling although some cheaper models are now coming to market which do not have this facility. Within the wider Europe the same pattern may emerge. To ensure full access for hearing impaired users there is a clear argument that through standardisation all decoders sold in the EC must be able to decode subtitling. The same applies to audio description, where the cost of introducing the AD decoder in all receivers would be offset by economies in large-scale production. The ability of DVB decoders to provide these facilities must be clearly indicated at the point of sale. As above it is recommended, perhaps in conjunction with the DVB board, that standardisation organisations draw up and then promote an easily recognisable symbol that indicates compliance with these minimum functions.

### **5.1.8 Capacity**

It is noted that many set top boxes appearing on the market do not have the processing capacity to carry captioning or subtitling services within the graphics plane alongside EPG's, interactive services and other on-screen graphics. Such restrictions clearly disadvantage sensory impaired users. All receiving equipment therefore should as an option be capable of displaying captioning and subtitling services alongside other textual services. As separate signing streams develop these too should include this requirement for part of a manufacturer's range. The ability to perform these functions should be included in the recommended basic standards for a receiver terminal.

### **5.1.9 Base-line Receivers**

Agreement at a meeting held at CENELEC on 12 March 2003 was that CENELEC/EBU/ETSI Joint Technical Committee and EICTA will work towards a base line receiver. It is also noted that the UK Government's Digital Action Group are working on a baseline receiver. It is therefore imperative that any ongoing work should be co-coordinated to ensure that the needs of disabled people are included from the outset.

### **5.1.10 Profiling**

The Design for All – Executive Summary Report<sup>34</sup> refers to the possibility of terminals storing different profiles for those family members who have different needs. For example people who need background colours to give good contrast or different volume control settings. The unit could also provide automatic selection of subtitling or audio description. It is noted that within the above Design for All, Standard CEN TC 224 WG 6 that profiling was to be considered as Medium priority in Q3/2000 and this should be pursued.

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<sup>34</sup> Design for All ICTSB 15.05.2000 Annexe B page 20

## 5.2 Interactive television access

Interactivity is considered by some as a major method of interaction between the public and public offices, to include government. It is essential therefore that disabled people should not be disenfranchised from access to these services.

PC displays vs. TV screens. Take up to date has however been limited with more reliance on the Personal Computer rather than through use of a television and a set top box. In some part this may be due to the display of the television screen when compared to that of an SVGA monitor where the TV's resolution relies on interlace and a more limited line structure. The resulting "on screen" presentation can have severe limitations for particularly blind and partially sighted people. It is recommended that standardisation organisations draw up European guidelines similar in manner to the US for example: Web Content Accessibility <sup>35</sup> The guidelines should include particular note that all official websites must adhere to the minimum principle that the content may be viewed on a television screen with its display limitations when compared to the SVGA screen of a PC.

## 5.3 Remote Controls

Regarded as the essential tool for access to television it is probably the most criticised by the viewing audience. While some manufacturers have made great efforts in designing an attractive yet useable device there are still many units which confuse by their appearance alone. It is appreciated that there is a wish to "badge" a receiver's remote control thus identifying the manufacturer's product. Nonetheless there is also a strong argument for some form of uniformity especially in the layout of buttons, their size and labeling. A major criticism is often voiced about the number of buttons on the face of the control unit particularly amongst the lower priced TV receivers. A number of recent reports has drawn attention to remote controls, details of the reports are found in the Reference Section. The following is drawn from these reports with additions.

### 5.3.1 Shape and size

The unit should be comfortable to hold and be useable by either hand. It should not be miniaturised to the point of while looking attractive it becomes unusable by less dexterous people. The construction of the body should be of non-slippery surface.

### 5.3.2 Buttons and controls

Unit Design. Only the minimum number of functions should be on the "face" of the unit. Secondary controls should be placed under a cover which should be easy to open. While retaining the individuality of units it should be possible to arrive at a common layout. For the most commonly used functions some convention is beginning to appear. By example placing the "off" and mute buttons at the top followed by the four coloured buttons. The buttons should be arranged in the conventional fashion of red, green yellow and blue. The

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<sup>35</sup> Web Content Accessibility Guidelines 1.0 W3C Recommendation 5-May-1999 (<http://www.w3.org/TR/WAI-WEBCONTENT/>).

central area should have a larger circular select button surrounded by arrows denoting up, down and sideways.

Buttons. Buttons should not be too small, wrongly shaped and narrowly spaced. They should be operated independently avoiding “double key” pressing.

They should be easily seen against the background, especially in terms of colour and contrast. The symbols or labels should not rub off. There is a clear opportunity here for a standard set of terms and symbols.

All buttons should incorporate a “positive” feel when sufficiently depressed.

Essential buttons should be of different size and shape thus providing an intuitive “feel”.

The main TV or set top box should indicate that a button has been depressed; for example by the illumination of an LED.

Confusion with complex menu paths would be eased by the introduction of an “Exit” or “Return to start” button. The terminology or symbol used however needs to be standardised.

It might be particularly helpful for those with dexterity problems or sight impairment if an “all in one” remote control became available that had similar buttons and controls as the “Big Button” telephone. Further consideration to this suggestion should be made in collaboration with organisations representing blind and sight impaired people such as the European Blind Union.

Direct Access. Commonly used services should be accessed by a single button and one plea often repeated by hearing impaired people is the need for a direct button to subtitles so that when subtitles are selected channels may be changed and subtitles will always appear.

Tactile Indicators. Tactile indications should incorporate ES 201 384 (1998-12) “Human Factors Telecommunication keypads and key boards-tactile identifiers”. Convex and concave buttons may also help some users. Further communication is recommended with the European Blind Union and similar bodies to determine whether additional recommendations are needed for TV remote controls.

Intra red transmission. Infirm people and those with dexterity problems would welcome remote controls whose infrared transmission links work from any angle.

Location indicator. A common difficulty experienced by many people not least for blind and partially sighted users is locating the controller after use. Many DECT telephone hand sets incorporate a button on the base station that initiates an audible alarm on the handset. It is recommended that this practice be extended to remote controls.

### 5.3.3 Interoperation

All-in-One. With the proliferation of “black boxes” in the home, each with its own remote control (TV receiver, VCR, DVD, Set top box, Hi Fi) serious consideration must be given to remote controls that could interoperate with other devices. The advantages are clear: for example a single control for commonly used functions such as channel change and volume control. The familiarity of one controller brings ease of use. Already some manufacturers such as BSkyB in the UK provide a controller which operates the TV as well as the set top box.

Remote control code conflicts. A further confusion caused by some controllers is exacerbated where the codes conflict with other controllers. Standardisation or at the least some form of registration would resolve this area of confusion.

## 6. Electronic Programme Guides (EPG's) and navigational menus.

Digital television is able to offer an array of services far beyond the limited number of channels in the analogue era. While it is still possible to “zap” through the channels to see what is available at that time the task of planning beyond the next hour on some platforms is practically impossible. With the proliferation of themed channels the advent of PVR's and Video On Demand the traditional one stop form of “scheduled broadcasting” may find less favour with viewers. Because of this programme guides in electronic form, either through an EPG or a navigational mechanism have become a necessity. Indeed without their use certain services may no longer be accessible. Research by NOP/World in 2003<sup>45</sup> however shows that many people, particularly the elderly, do not know how to access analogue subtitles on their televisions. This problem will be exacerbated as consumers are faced with increasingly complex Electronic Programme Guides and a range of interactive services.

EPG Construction and Display. In general the EPG's are likely to be provided by the broadcasters themselves or in the case of Navigational Mechanisms generated in the receiver derived from meta data provided by the broadcasters. The form of presentation can be a simple “Now and Next” format to a full programme and service menu detailing information for that day and beyond. It is essential therefore that certain safeguards are built into these forms of guidance:

- All information that is visually displayed, such as EPG, interactive menus for pay per view etc, should be available electronically at an external connection point (standard or special port) to facilitate the use of special assistive devices (e.g., voice synthesizers, Braille printers). The information should be available in an industry standard format.
- Where there is access to additional services (e.g. automatic VCR or PVR programming), then a standardised interconnections and data protocol should be used between all the component parts that use these services.

- The presentation of text and graphics should follow the principles set out in the On Screen Graphics Section 8.
- All information should be intuitive and logical. Menu structures should be simple each following a similar pattern path. It is recommended that a standard set of commands is derived for basic navigation tasks.
- Commands given by the remote control should follow an obvious pattern using a minimum number of keys and keystrokes. (Compliant with the 'General Consumer Principles for Standardisation relating to the Information Society'<sup>36</sup>)
- In conjunction with the remote control there should be single button that returns the viewer to the opening menu.
- Any index should be easy to use and any programme classification system should be easy to understand and unambiguous.
- Essential services such as subtitling or audio description must not be buried within menus making them difficult to access. Once the service has been selected it should become available from "switch on" and "channel change" unless turned off by a dedicated toggle on the remote control.
- All programme information relating to services carrying subtitling, audio description or signing must indicate this either in the text or a commonly recognised symbol. It is recommended that standardisation organisations devise a symbol for each of these three provisions. It is noted that the Design for All Executive Summary<sup>37</sup> recommended developing standard symbols for marking way-finding technology under SO SC 35. ITU-T E.121. Reference may also be made to the following ITU guidelines:
  - Pictograms, symbols and icons to assist users of the telephone service. ITU-T F.902 (02/95), Interactive services design guidelines. ITU-T F.910 (02/95) – Procedures for designing, evaluating and selecting symbols, pictograms and icons.
  - The provision of additional information should be in a standard meta-tag form that is compatible between Electronic Programme Guides and other programme indexing recording or logging systems;
  - Terminology must be limited to easily understandable terminology rather than proprietary terms which may cause confusion.
  - Seldom used commands or information should be hidden
  - Viewers should be able to customise screen displays, for example to make the text large or change the colours and contrast
  - Interactive menus on the screen should use direct selection techniques where practical.

## 7. Production of Assistive Services

The common forms of assistive services for sensory impaired people are subtitling, audio description and signing with the former having been provided in some countries for over 30 years either in open or closed form. To date few

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<sup>36</sup> As related in ANEC2003/ICT/008 January 2003 5.2 DIGITAL BROADCASTING AND RECEPTION page 18

<sup>37</sup> Design for All Executive Summary 15 may 2000 GEN 18 page 14 (07/96)

codes of practice or guidelines exist although some are now beginning to emerge; for example Subtitulado para personas sordas y personas con discapacidad auditiva.<sup>38</sup> Subtitulado a través del teletexto (PNE 153010) soon to be published and <http://www.joeclark.org/access/description/> During the Seville Workshop the EBU agreed to provide a resume of best practice for subtitling. It has been agreed that these will be compiled in time for the final report due in November. However in the meantime as a basis the following guidelines are drawn from recommendations by the FDPEDA<sup>39</sup> and the ITC<sup>40</sup> which are of a form generally accepted as minimum production standards.

## 7.1 Subtitling

Minimum Guidelines and Best Practice. Reduce viewer's frustration by:

- Providing subtitles as near synchronous to speech as is practicable
- Allowing adequate reading time
- Reflecting the spoken word with the same meaning and complexity without censoring.
- Constructing subtitles to contain all obvious speech and sound effects
- Taking care with shot changes
- Constructing subtitles which contain easily read sentences and commonly used sentences in a tidy and sensible format
- Placing subtitles in time and place
- Giving particular regard to the intended audience e.g. to include children.
- Giving good contrast between foreground and background colours
- Using Tiresias as the digital subtitle font or good equivalent.
- Using text height of 24lines high on the capital letter Y.

## 7.2 Audio description

Minimum Guidelines and Best Practice. These have been derived from recommendations by the Royal National Institute of the Blind (RNIB) and from the above ITC Guidelines as follows:

- the description should provide key information, e.g. who, where, when, what
- the description should be in the present tense
- the description should not intrude into the dialogue
- the music and effects should be used to enhance the description, as well as the original dialogue
- omit the use of unnecessary personal pronouns – e.g. “Now we see...”

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<sup>38</sup> Subtitulado para personas sordas y personas con discapacidad auditiva Subtitulado a través del teletexto (PNE 153010)

<sup>39</sup> [European Federation of Parents of Hearing Impaired Children \(FEPEDA\)](http://www.fepeda.org/) Policy on Television Broadcasting for Deaf and Hearing Impaired Children Draft 2 24/05/99

<sup>40</sup> [http://www.itc.org.uk/itc\\_publications/codes\\_guidance/index.asp](http://www.itc.org.uk/itc_publications/codes_guidance/index.asp)

- describers should not voice a personal opinion or interpret events. The description is there to clarify what is going on
- do not state the obvious
- for clarification use pronouns and place names.

### **7.3 Signing**

Minimum Guidelines and Best Practice. To date there would appear to be little advisory information about the sign language interpretation for television. However the following ITC guidelines were derived following extensive discussions with the UK deaf organizations and experts in the field of signing.

- The interpreter should occupy at least one sixth of the screen.
- Appropriate clothing should be worn to ensure good contrast and that the interpreter's hands are visible.
- The interpreter should be of sufficient size and resolution to show all movements of the full upper trunk together with arms, hands and fingers, shoulder, neck and all relevant facial movements and expressions. The important component of lip speaking must also be discernable.
- Gestures that convey meaning through sign language must be easily and accurately recognised.

## **8. On Screen Displays**

As indicated in Section 5.2 television screens do not have the resolution of a PC monitor. As such severe limitations are placed on viewing textual information particularly for blind and partially sighted. When designing on screen text and graphics the following should be borne in mind.

- The optimum viewing distance from a TV screen is typically about 5 to 6H (where H = height of the screen) although most people sit further away than this distance.
- All text should be within the defined 'safe area' which is nominally 80% of a 14:9 screen.
- All text to be sans serif typeface of the Tiresias form and at 24-point minimum.
- Light text on a dark background is easier to read on a TV screen.
- Use simple screen layouts, or provide the user with the option to look at one thing at a time.
- Whatever form of presentation engine and receiver is employed there must be sufficient capacity to allow display subtitling coincident with other textual information.
- Further information can be gained from the RNIB ([www.rnib.org.uk](http://www.rnib.org.uk))

## 9. Interoperability

It is noted from the report to CENELEC, Standardisation in Digital Interactive Television<sup>41</sup>, “that the lack of interoperability on the software level, and the hampering development of open, horizontal markets for interactive content and digital interactive receivers in Europe, are considered by many to be the key issues”.

Recent pronouncements by the EC<sup>42</sup> have referred to Article 17 of the Framework Directive. These have indicated that unless the objectives of the Article are not reached through implementation at a Member State level by July 2004 it can decide to make the relevant standards and specifications compulsory. These comments have however attracted some criticism.

Multiple Boxes. For the disabled consumer and especially those with limited disposable income there are particular implications here. Little is to be gained if access to all platforms can only be gained through multiple set top boxes. Yet as many of their design principles are being based on the MPEG2 architecture a relatively simple modification should allow, say, a terrestrial set top box to decode both satellite and cable services as well. Many consumers would find it hard to find any other widely used product to be so restrictive. Further, where conditional access system (CA) is used, all equipment should allow modifications to the proprietary CA, thus providing Open Standards.

Interoperability of digital TV equipment, whatever platform, should also extend the provision of adequate capacity to allow carriage of both interactivity and subtitling/signing and /audio description.

As a step towards these aims many argue that support should be given to the Multimedia Home Platform (MHP) and its ability to work alongside such existing engines such as MHEG5.

## 10. Recording Equipment

Analogue VCR's. By far the most common medium for recording is still the VCR in its VHS form. While for most viewers this format has proven to be highly successful, due to the lower bandwidth used it cannot record the analogue teletext form of subtitles. Versions of the S-VHS format are to some degree able to do so but interchangeability of tapes between different makes of recorders is not always successful. Some manufacturers produced specially adapted VCRs that were able to record subtitles but these and the S-VHS versions have mainly been withdrawn from the market. VHS machines used in the AV mode can however record digital subtitling because once selected the subtitles they form part of the picture. A downside is that the recording may only be made on the channel selected on the set top box or

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<sup>41</sup> Standardisation in Digital Interactive Television Final version April 2003 page 4

<sup>42</sup> Mr Erkki Liikanen Member of the European Commission, "Convergence and the challenges to Europe's broadcasting industry" IDATE Conference on Telecom - Internet - Media: Europe Moving On Montpellier, 22nd November 2000

idTV. Specialist analogue subtitle recording devices are still available such as Telemole.

Digital VCR's and PV's. There are faint signs the digital VCR's with their built in decoder may appear on the market. New to the market however are disk recording devices with local storage known as Personal Video Recorders (PVR's). These allow TV programmes to be recorded according to viewers' preferences by analysing content descriptions ('metadata') broadcast along with TV programmes and comparing these to the preference profile of the user. It is expected that PVR's will revolutionize the way people watch television. Trailer recording, group recording, remote programming and segmentation offer broadcasters and content providers new ways to attract and keep their viewers. Proprietary PVR's, where the consumer device and metadata service form a closed system, such as SkyPlus, have been deployed for some time and require subscription.

Open Standards. For more general use however there are clear advantages for a PVR system similar to the TV-Anytime<sup>43</sup> open standards consortium. Such a system may be considered for standardisation. Of overarching importance however is that all PVR's and Digital Video recorders must have the ability to record and play back subtitles, audio description and signing. They must also have the ability to record one service whilst another is viewed on the main screen. It is also recommended that any recording device should follow the principles outlined in Section 5.1.5 (Interconnections)

## **11. Retention of Recordings**

Experience in parts of Europe has shown that it is possible for previously recorded material with subtitles to be retained by the broadcaster or subtitling company then passed to a third party for a later broadcast. The relatively small fee charged thus obviates the cost of re subtitling the whole programme. It is suggested that the EBU or body should hold a list of previously subtitled material that would be available for exchange. Similar consideration should be given to audio description.

## **12. Promotion of Assistive Services**

Input from representative groups for sensory impaired people to the Working Group indicates that there is widespread concern for the variable nature of assistive services across Europe. While some countries are moving towards high levels of service through quotas mandated by national regulation or through voluntary schemes by the broadcasters themselves, others are lacking in any meaningful provision. It is often quoted and argued by representative bodies that it is a democratic right of all citizens to have access to television services and especially those of Public Service Broadcasts. A

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<sup>43</sup> <http://www.tv-anytime.org/>

stated aim of the European Year of People with Disabilities<sup>44</sup> is “to reinforce the co-operation between all parties concerned, namely government, the social partners, NGOs, the social services, the private sector, communities, voluntary sector groups, people with disabilities and their families”.

Awareness of Services. Mandatory or voluntary assistive services in themselves are, however, not necessarily sufficient. Recent research<sup>45</sup> shows that people over 65 are less likely to be aware of subtitling compared to younger people. Furthermore, there are still signs that, despite closed subtitling being available for some 25 years, some viewers do not know how to access the service. It follows that promotion of assistive services and how to use them is needed through the whole chain: broadcasters, manufacturers, point of sale, social services, listings magazines newspapers – indeed any body that has contact with disabled people. Such promotion can be through:

- details within EPG's and programmes listings
- programme listing magazines and newspapers
- special promotional advertisements or trailers
- use of a recognised symbol at the commencement of each programme
- point of sale promotion and recognised symbols or tickets on each device
- awareness by social workers and carers
- representative groups activities/publications, including websites

### **13. Future developments**

SAMBITS. A number of innovative products that might aid assistive services are coming forward. Not least of these is the SAMBITS (System for Advanced Multimedia Broadcast and IT Services)<sup>46</sup>. Supported by leading European research establishments, manufacturers and representative organisations the intent is to “bring MPEG 4 and MPEG 7 technology to the broadcast industry and the related internet services. The project will be able to provide multimedia services to a terminal that can display any type of general interest integrated broadcast/internet services with local and remote interactivity.” A specific proposal within SAMBITS has been made by the RNID and RNIB to create a SAMBITS terminal in the form of a set-top box that will allow disabled people to receive digital television and Internet broadcasts. The terminal will be specifically built to allow individuals with hearing impairment, speech impairment and/or visual impairment to take full advantage of the broadcasts. The terminal will require to decode:

- a) All available media streams or a selection of available streams according to the users own abilities and preferences;

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<sup>44</sup> European Year of People with Disabilities The objectives of the Year  
[http://www.eypd2003.org/eypd/about/theyear\\_en.jsp](http://www.eypd2003.org/eypd/about/theyear_en.jsp)

<sup>45</sup> NOP World 420703 January 2003

<sup>46</sup> [http://www.irt.de/sambits/documents/ibc\\_SAMBITS\\_overview.pdf](http://www.irt.de/sambits/documents/ibc_SAMBITS_overview.pdf)

- b) Captioning and subtitling
- c) Signing through either secondary video streams, compressed or otherwise or by means of an avatar
- d) Audio description

“Talking” EPG. WGBH-TV in Boston has created a National Center for Accessibility to Convergent Media (NCAM). One NCAM project is developing an Access to Convergent Media Project<sup>47</sup> to specifically address the usability of an electronic program guide (EPG) by individuals who are blind or partially sighted people thus improving access. Use of the EPG in this way is likely to enable blind users to successfully interact with other services delivered through the set-top box such as e-commerce, web browsing, programme enhancements, and other interactive features. It is understood that similar work is underway in the UK by the ITC and BSkyB.

Personalisation Agents. The European Design for All e-Accessibility Network (EDeAN) has drawn attention to the possibility of personalisation agents that can make it possible for digital systems to automatically track and adapt to individual user behaviour and preferences. The same type of technology being used to block children from watching adult material could easily be adjusted to allow for individualised settings and applications. For example: adaptation to include descriptive captioning for blind and partially sighted users, alternative font sizing and colour contrast or adaptable electronic program guides EPG's. More investigation is needed in order to explore the potential for the use of PVR's , adaptable programme guides and this type of new technology with an eye toward adapting it for users with special needs. Further details on this concept can be found at:  
<http://www.vtt.fi/tte/samba/projects/adaptive/usability.html>

European Research Centre. It is suggested that a European Research Centre, similar to NCAM, should be formed in order to further develop such concepts that might not receive the attention of the more conventional research agencies.

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<sup>47</sup> <http://ncam.wgbh.org/convergence/epg.html>

## 14. Recommendations

While this report throughout refers to a number of tentative recommendations, as set out below, it is considered that more consideration is needed before making any definitive comment. The intent therefore is for the report to act as a catalyst for stimulating debate both within the TV for All working group and by other bodies. One such suggestion already made is that the needs for disabled consumers should be built into television standards. The appropriate bodies to oversee this would be the European standards bodies CENELEC, CEN and ETSI. They in turn should establish a disabled users committee to ensure that they take these issues on board when standards are drafted. This would ensure the recommendations contained in CEN/CENELEC's Guide 6<sup>48</sup> are implemented by manufacturers are put into practice. This body should also liaise with manufacturers to ensure that the needs of all consumers are taken into consideration when products are designed. By no means exhaustive the following may also be considered:

- Adoption of the (Section) 4.1)
- Good aerial practice (Section 4.1)
- Use of DVB Subtitling ETS 300 743 V1.2.1 (Section 4.2)
- Consideration given to Audio Description in the DVB Implementation Guidelines (Section 4.3.2)
- Develop a consensus towards interoperability (Section 4.5 and Section 9))
- Development of a single “base line” receiver. (Section (4.5)
- Creation of a conformance and certification testing (Section 5.1.1)
- Agreement towards standards for receiver control functions, labeling of switches, dials their sizes (Section 5.1.2), connectors (Section 5.1.3 and connectivity guideline for equipment (5.1.6
- Standards towards means of upgrading receivers (5.1.5)
- A minimum standard for receiver assistive service decoding ability (Section 5.1.7).
- On-screen displays standards or guidelines for: resolution of “on-screen” interactive information (Section 5.2).
- Standards or guidelines for text, graphics and safe areas (Section 8)
- Minimum standards for remote controls: size, shape and usage (5.3), tactile surfaces and audio alarm when misplaced (Section 5.3.2)
- Consider interoperation of remote control units (Section 5.3.3)
- Minimum standards and guidelines for EPGs (Section 6)
- Subtitling, Audio Description and Signing best practice (Section 7)
- Creation of a central register of previously recorded assisted programmes (Section 11)
- Promotion of assistive services by broadcasters, newspapers and by NRA's in general (section 12)
- The needs for disabled people to be built into standardisation procedures (section 13)

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<sup>48</sup> CEN/CENELEC's Guide 6 “Guidelines for Standards Developers to address the needs of older persons and persons with disabilities”

## 15. Recommendations relevant to CENELEC

As a result from this report being circulated and the proposed meeting in Barcelona 28 October 2003 the final report will contain further comment and make recommendations in appropriate areas. In the meantime however in particular it is recommended that CENELEC consider standardisation in the following areas:

1. Standardise the EBU File transfer format 3264
2. Proceed with standardising DVB Subtitling ETS 300 743 V1.2.1
3. In conjunction with other bodies develop a consensus towards interoperability with MHP as the main API.
4. Derive minimum standards for receiver control functions, labeling of switches, dials etc.
5. Develop minimum standards for interconnections and their connectors to include colour coding.
6. Develop minimum standards for remote controls to include their size, shape, and buttons for clarity of marking and usage. Also to develop a set of recognizable symbols to denote functions.
7. Develop a minimum standard for the decoding of assistive services. That is to say ensure that all DTV decoders sold in the EC have the ability to decode the main forms of assistive services.
8. Together with EICTA and the EBU establish a conformance centre for DTV terminals and displays.
9. Together with EICTA develop a standard for a single "base line" receiver. (As this is being considered by the UK Government's Digital Strategy Group there would be a role for CENELEC ensuring that any standard is applicable Europe wide).
10. Develop minimum standards for upgrading receivers in order to avoid receiver "legacy" problems. This could be achieved in partnership with manufacturers.
11. Consider if, in conjunction the EC, it is practicable to produce standards for on-screen displays derived from the Internet especially those sites provided by government organisations.
12. In conjunction with the EBU develop standards, or at least produce guidelines, for a "safe area" to display essential text and graphics.
13. In conjunction with broadcasters explore the possibility of minimum standards and guidelines for EPGs.

## 16.. Conclusion

The unique opportunity offered by the formation of the TV for All Working Group on standards has the potential to attract a significant proportion of European disabled people to the use of digital television. If realised then the resulting benefits will be felt not just by disabled people but also by the wider population of consumers as a whole.

It has been voiced that many elements towards making an attractively designed product are relatively simple - costing little more than attention to such details as clear and understandable labelling. The use of plain language terminology and the provision of a well designed remote control units with direct access to essential services would surely have a high value to the user yet incur only limited cost to manufacturers. Other elements such as the addition of tactile surfaces, clear on-screen text and intuitive menus are also unlikely to carry a high cost penalty. It follows that by opening a dialogue with representatives of disabled people and taking their opinion could lead to many more small but significant improvements.

To achieve any form of progress in taking these suggestions forward however will need the co-operation of a number of bodies. Clearly as CENELEC and ETSI initiated this process they will have a lead role to be play here. Manufacturers will need to be convinced there is value in making equipment which really is TV for all people while broadcasters must be confident that there is a market for assistive services. This process can commence by CENELEC widely distributing the report, especially the Executive Summary and Recommendations, to broadcasters (EBU members and non-members), the Joint Technical Committee, NRA's and national manufacturing associations. Once the report is digested open meetings and workshop should be arranged by CENELEC to seek a constructive dialogue between parties and determine what is practicable. By taking these initial steps as outlined in the foregoing paragraphs progress may well be possible before the Barcelona meeting.

In a similar vein CENELEC are recommended to revisit their Design for All - Final Background Report, Chapter 7 Digital Broadcasting and the Design for All - Executive Summary Report, Recommendations for Digital Broadcasting. These reports contain the wealth of information but they were published in 2000 and since then in the light of Digital Television being introduced in Europe much has been learnt by manufacturers and broadcasters. It follows that the Work Items, their Deliverables and Areas of Responsibility may have changed, as may have the Timetables and Priorities. These should be reconsidered alongside the recommendations for CENELEC as given in section 15. Following a revision of the reports they should be published and given the widest circulation amongst appropriate organisations.

Opportunities should also be taken within the European Year of People with Disabilities to promote the need for standards. In part this can be achieved by CENELEC publishing the report on the designated website <http://www.eypd2003.org>. It is also hoped that publicity will be gained by

referring to the Interim Report at the Congress on Media & Disability taking place in Athens on June 13-14.

It is hoped therefore that this report will stimulate further discussion on how TV for All can be achieved. At the proposed meeting in Barcelona on 28 October progress so far can be discussed and presented in the final report due in November 2003. The result of all the above, if successful, could lead to enhancing Digital Television's role as the pre-eminent driver in ensuring that all citizens have a share in the Information Society.

## Glossary of Terms

**Accessible** Content is accessible when it may be used by someone with a disability.

**API** Application Program Interface used in interactivity within a receiver terminal where software interfaces between the receiver's own resources and the form of broadcast applications it receives.

**Assistive services and technology.** Software or hardware that has been specifically designed to assist people with disabilities in carrying out daily activities.

**ATSCC** Advanced TV Systems Committee originally formed in the US to investigate the many proponent advanced TV formats that were emerging in the US during the late 1990's

**Audio Description (AD)** An ancillary component associated with a TV service, which delivers a verbal description of the visual scene as an aid to understanding and enjoyment particularly, but not exclusively, for viewers who have visual impairments. The description content is voice only, in mono, and is typically confined to gaps in the normal programme narrative.

**Avatar** An image of a human derived by means of a Virtual Reality application.

**CENELEC** European Committee for Electrotechnical Standardisation

**CEN** European Committee for Standardisation

**DTG** Digital Television Group comprising broadcasters, manufacturers, regulators and interested parties

**DTT** Digital Terrestrial Television

**DVB** The Digital Video Broadcasting Project industry-led consortium of over 300 broadcasters, manufacturers, network operators, software developers, regulatory bodies and others in over 35 countries committed to designing global standards for the global delivery of digital television and data services.

**EBU** European Broadcasting Union

**EICTA** European Information Communication and Consumer Electronics Technology Industry Association

**EPG** Electronic Programme Guide

**ETSI** European Telecommunications Standardisation Institute

**FCC** Federal Communications Commission

**MHEG5** Multimedia and Hypermedia Expert Group. A standard for interactive applications it defines a set of objects that can be arranged into applications. An MHEG application would typically be used in applications such as digital TV. The variant MHEG-5 defines the specific classes of object available to the application creator.

**MHP** Multimedia Home Platform (MHP) defines a generic interface between interactive digital applications and the terminals on which those applications execute. It decouples different provider's applications from the specific hardware and software details of different MHP terminal implementations. Agreed by ETSI it has two versions: 1.0.2 for enhanced and interactivity and version 1.1 supporting Internet access. A further version 1.0.6 is in progress.

**MPEG 2/4 and variants** Motion Picture Expert Group – the tool box from which a variety digital transmission format are based

**Navigation Mechanisms and menus** The means by which a user can navigate a page or site.

**NRA's** National Regulatory Authorities

**Open Standards** An agreed non-proprietary specification free of intellectual property rights (IPR) and discrimination thus allowing interoperability. The MHP specification is such an example of an open standard API.

**OSG** On Screen Graphics

**PVR** Personal Video Recorder. Recording devices utilising disk storage as opposed to video tape in a VCR. TVAnytime and Sky Plus are examples of this.

**Screen reader** Software program that reads the contents of the screen aloud to a user. Screen readers are used primarily by individuals who are blind. Screen readers can usually only read text that is printed, not painted, to the screen.

## Documentation

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The Universal Service Directive 2002/22/EC

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CEN/CENELEC Guide 6 Guidelines for standards developers to address the needs of older persons and persons with disabilities Edition 1 / January 2002

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ETSI Enhanced Teletext specification ETS 300 706

VBI Subtitle Mapping to DVB Subtitles Version 1 (Subtitles group of the U.K.  
Digital TV Group).

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ES 201 381 V1.1.1 (1998-12) Human Factors (HF); Telecommunications  
keypads and keyboards; Tactile identifiers

Submission to the EC on Subtitling and sign language – Television Without  
Frontiers directive RNID 29 July 2002

TV Broadcasting for All List of Domains. RNID April 2003

## **Organisations providing input to TV for All**

Asociación Española de Normalización y Certificación (AENOR) European

ANEC European Association for the Co-ordination Representation in Standards

DBC Deaf Broadcasting Council

European Disability Forum, EDF

European Federation of Hard of Hearing (EFHOH) EFHOH

European Federation of Parents of Hearing Impaired Children (FEPEDA) FEPEDA

Hearing Concern

European Design for All e-Accessibility Network (EdeAN)

RNID

Royal National Institute of the Blind, UK RNIB