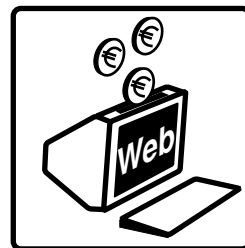
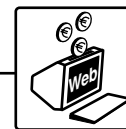


## *Chapter 13*

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# ***Internet and Electronic Commerce***





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## Introduction

The emergence of the World Wide Web has made it possible for individuals with computer and telecommunications equipment to interact as never before. For elderly and disabled persons the Web holds great promises of transforming past barriers to information access. But as with any new technology, new barriers can arise in place of the old.

The percentage of people with disabilities in many populations is between 10% and 20%. The age group over 60 is the most rapidly growing and there is a large overlap between these two groups (elderly and disabled). This chapter focuses on disabled persons keeping in mind, that elderly persons, especially those with or developing impairments, have the same requirements and will benefit from the same solutions. For example, a clear structured Internet site will not only help blind persons, but will help everybody including those with cognitive impairments.

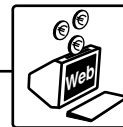
Not all disabilities affect access to information technologies such as the Web, but many do. Just as with other parts of the population, not all people with disabilities have access to the Web. But the number of people using the Web is steadily increasing, and for people with disabilities, access to this technology is sometimes even more critical than for the general population which may have an easier time accessing traditional sources of information such as print media.

As information and services including remote control are being transferred to the Internet, more than one in four persons will not have access to it, if the content on the Internet is not accessible for inexperienced or disabled users. This will create a digital divide. The "old-fashioned" personal services are being closed or drastically reduced to allow cost savings and the user has to pay additional fees for using them. For example, a banking account accessed via Internet is free or low-cost but the "ordinary" accounts costs the user more. A directory enquiry request about phone numbers via Internet is free but very expensive via the telephone service. Special low-cost telephone services for disabled persons have been closed in some countries.

New services will be started using the Internet only. The implementation of additional alternative services will not be undertaken due to cost. Therefore Internet services must be accessible for all!

This chapter is divided in to three major parts:

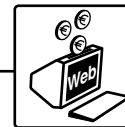
- Currently the personal computer is the most prominent tool for accessing the Web and it is the most flexible supporting individual configuration of soft- and hardware and driving assistive technology. Chapter 13.2 focuses on methods for disabled persons to access the computer. For using the Internet with other devices see the relevant chapters.



- A barrier free Internet presumes a proper use of all Internet technologies. They are described in detail in chapter 13.3.

- An important factor in the growth of the Web is Electronic Commerce: The ability to buy, sell, and advertise goods and services to customers

and consumers. This is done by extensive use of Internet technologies. Chapter 13.4 focuses on some special aspects for making these important services accessible for all.



## Access to the Computer

Currently the computer is the most prominent tool for accessing the Web with the help of special software, the so called Web browser. The way persons with different disabilities access the Internet therefore depends highly on the techniques they use to access the computer and the browser.

This chapter will focus on persons with a high degree of disability who often need assistive technologies for computer access. But this is of course the group of persons who could most benefit from the Internet.

Home banking, Internet shopping, information retrieval and the new facilities of communication are inconceivably large steps for the single individual living independently.

Because of the necessity of special devices, most internet usage takes place at home or at work.

In general, operating systems are preferable which provide a clear user concept like Linux or Windows NT. Special settings for the

environment are dedicated to a user. Other users, for example a non-handicapped member of the family or a colleague, may use the same computer with their own settings and need not accept the settings of the disabled person. In this case, the non-disabled user may not be able to change settings of the disabled user accidentally or with good intention. This is very important. For example, a screen reader program for a Braille display is told to identify an error message in a certain program by a colour attribute. If this attribute is changed, the blind user isn't able to work with the program. Help of a sighted person is required.

Some applications need response in a certain time interval. For example: a boot manager will start a predefined operating system if there is no other selection by the user within a few seconds. If this mechanism can't be disabled, those persons, who need some time to recognise the situation or to handle the keyboard will have problems.

## Physically or Motorically-Impaired Persons



This group of people often need special furniture/ equipment in which to place the input and output devices of the computer in order to be able to use it. In most cases, they are able to use the standard monitor, but may profit (as can all users) from the space saving and light weight of the new flat screen TFT monitors. In general, a wireless remote control for monitors is desirable (in principle, it is sufficient if there is a remote control version available for each monitor type, but currently there isn't one for the TFT types on the market.)

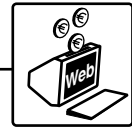
Most operating systems offer basic accessibility support for standard keyboards and mice like macro definition, sticky key support (press one key only at a time) etc.

Special keyboards are available with extra large keys for people with reduced motor capacities/ skills. Small keyboards enable people with

Thalidomide-induced handicaps, MS patients, people with only one hand and those who only can operate the computer by using mouth-sticks, to handle the PC. Miniature versions are available for people with severely restricted movements. Keyboards for patients with muscular dystrophy are available with a specially adapted grip panel so that they can be operated with the minimum amount of physical effort.

Most keyboards are provided with a continuously adjustable keystroke delay, double keystroke prevention, adjustable key repeat speed and a latch for the modifier keys such as SHIFT. In addition, all special PC keyboards can be provided with a mouse or trackball control which is specially adapted for handicapped persons.

These are good examples where ICT standards exist for assistive technologies, because these



devices use well known computer interfaces like PS/2, serial port, USB and they are not detected as special devices but ordinary equipment by the PC and the operating systems. Wireless keyboards and mice allow a wide range of placement of the devices. But this facility is not currently provided on special keyboards and pointing devices.

Additionally, pointing devices like a head mouse or an eye mouse allow pointing and select operations by the motion of the head or the eye. Even a keyboard may be simulated! These devices are a combination of hardware and software and therefore not independent from the operating system. They are available for Win95/98/NT/2000, but currently not for other operating systems.

Speech control of the PC and speech recognition is also very convenient for this user group. The current solutions need a huge amount of processor power and have to be trained for the voice of the operator for reliable results. The quality of recognition is rather good but the user has to observe the system for correct detection and reaction and has to intervene immediately. Incidentally this is the

reason why blind users don't prefer voice input; often they are even faster with a correct ten finger writing on an ordinary keyboard. Speech recognition is currently available for Win95/98 and OS/2. Development for Linux and others are in progress.

The rapidly growing market for speech recognition does not currently address the individual end user but professional use like call centre. Interfaces to speech control and speech recognition engines are:

- SAPI 4.0 (Microsoft Speech API) including text-to-speech:  
(<http://www.microsoft.com/IIT/OnlineDocs/intro2SAPI.html>)
- JSAPI 1.0 (JAVA Speech API) including text-to-speech:  
(<http://www.javasoft.com/products/java-media/speech/>)

Other less popular interfaces are defined by several companies. Of great significance is the lack of a standard of a platform independent specification for the semantics and contexts that a recognition engine may expect.

## ***Strong Hearing Impaired or Deaf Persons***



Current computer user interfaces are in general optically orientated which means more than 90% of the information is presented to the user in an optical way.

Hearing is often involved due to beeps or jingles for attracting the users attention for status or progress information, warnings and error messages. This information is very important. The visualisation of these signals is either integrated into the disability features of some operating systems or available as special programs (freeware) for all operating systems.

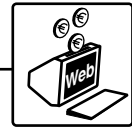
In contrast to sight, hearing is a surround sense. That means, you will hear an acoustic signal even if you are doing other things like reading a book and listening to music. The visualisation of acoustic signals on the screen requires attention of the user more

or less the whole time, especially when an immediate interaction response is demanded. The optical signal should not disappear without confirmation. Otherwise it may be overlooked.

Imagine pushing a program's help button and the system dials in to a server overseas to download brand new information by the modem automatically. Without hearing sounds from the modem you might not recognise this expensive event!

Currently there seems to be no standard for visualisation of acoustical signals.

Games are using sounds extensively for animation, but this sound rarely delivers additional information. That means, you can play most games without sound (and less fun).



Of course, a deaf person will not recognise sounds like voice mails, background sounds of internet sites, MP3-Files, etc. But though they are excluded from all information which is delivered exclusively in a pure acoustic mode, audio services will be provided more and more in the near future as a result of growing bandwidth available to the Internet.

On the other hand, most deaf persons have pronunciation problems and so they are not able to use a speech control or speech recognition system successfully. If voice is the only opportunity for device or application operation, they are excluded from using it.

## ***Visually Impaired, Strong Visually Impaired or Blind Persons***



The differentiation of the three groups is very important because of very different computer access. But the borders are rather flexible. In general the step from textual to graphical user interfaces (GUI) is a big advantage for well sighted persons, but not for the visually impaired.

GUIs presume the user is able to observe a complete screen at a glance, to identify and handle objects, to recognise symbols and identify functionality behind them, and to point to and select things.

Often information is given by the topology of elements on the screen, by colours or by motion. Some information will be presented for a short time only.

In general, the smaller the perception focus on the screen, the greater the problem of observing the complete screen. This problem increases with the enlargement of very small regions of the screen or by the use of nonoptical devices. Working as closely as possible to the original GUI ensures the unaltered information presentation. But a growing degree of visual impairment leads to an increasing level of abstraction: for example the mapping of the GUI to an acoustical user interface (AUI) which works in a quasi sequential manner.

For this reason one can observe visually impaired persons working with a voice output device or Braille display in the environment of well known applications but switching to enlargement tools or even the original screen presentation for a fast orientation or in unexpected situations and environments. Because of stress, this will work only for a short moment.

### **Visually Impaired Users**

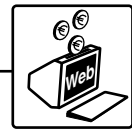
They try to access the screen by the use of physical vision aids like special glasses, loops, etc., and by large monitors. Persons with visual impairments often work with their nose immediately in front of the screen. And even if the monitor is TCO95 compatible, the danger of magnetic fields and radiation still remains for this very short distance. The higher illumination of TCO95 in contrast to ISO9241 is also very helpful.

A good replacement for conventional monitors are the new TFT flat screen monitors. They have less radiation, high luminance, are nonflickering and because of size and weight, can be placed optimally. But TFT flat screens are not feasible for all sight deficits. And the preferred large ones are currently very expensive.

Most of the current operating systems include some functionality for changing fontsize, fontstyle, colours of background and Text, ordering of the screen etc. This encloses all basic functionality of the operating system.

This user specific setting can be overtaken by applications. But many ignore this mechanism and have their own settings, which are sometimes but not always changeable by the user.

In contrast to many MS Windows applications, most Linux applications are featuring these concepts.



## Strong Visually Impaired Users

They access the screen by the use of enlargement programs so called "screen magnifiers". In principle, a screen magnifier enlarges the content of the screen up to 30 times. As the physical screen presents only a small part of the virtual screen, mechanisms for adjusting the focus and for the continuous movement of the focus etc. are needed. The colours may be changed to the special needs of the user.

Most screen magnifiers work purely in a graphic mode. They don't know anything about the content (like a fax machine). But there are new screen magnifiers derived from screen readers for Braille displays (see next section) which differentiate text and graphic.

These tools may change fonts of a text and even read a text to the user by a synthetic voice to unburden the eyes. Sometimes they are combined with a Braille display.

Since enlargement tools are software based they are therefore highly dependant upon the operating systems.

The concepts and handling of enlargement programs differ. It follows that a visually impaired person can use his configured PC very well, but a change to another computer isn't easy, even if a screen magnifier is installed.

Screen magnifiers for Linux are not available yet. The probable reason is that current window managers of Linux are scaleable in such wide ranges, that special solutions are not required. This saves the user from learning and handling an additional abstraction layer.

Keyboards with large printed letters on the keycaps with a high contrast are not only welcome for visually impaired users. Such a simple modification helps a great deal for searching infrequently used characters for non visually impaired.

Note: If there is a keyboard with an enlarged signature on the market, the enlargement is done only for the well known characters but not for special characters!

Additionally high efficiency LED's might help identify the current state of toggle keys (e.g. NUMLOCK). (There are programs available, mapping status information to the screen or presenting status toggles by sound.)

The realisation of these features in a multimedia keyboard (integrated speakers and microphone) or in a notebook would be extremely usefull.

## Blind Users

They access the screen by the use of so called screen reader or bridge software which translates the variety of concurrently presented information on the visual screen into an adequate textual presentation for perception on a tactical Braille display or by synthetic voice so called text-to-speech (TTS). Main tasks are:

- identify and handle objects,
- recognise symbols and name them,
- identify functionality behind symbols,
- point to and select objects by mouse simulation,
- follow cursors, (system, mouse or attribute cursor),
- watch specified events,
- identify information presented by topology, colours or motion,
- support for application specific profiling by a script language,
- orientation and movement of the current focus (currently presented part of the virtual screen),
- synchronisation of the focus of speech, Braille and enlargement.

Obviously, screen readers for GUIs are much more complex than for textual user interfaces like Linux or DOS. Though a blind user is not familiar with the visualisation techniques of GUIs, their interaction must be learned in any way, because of integration at work or the necessity of use that software all others are using. But sometimes, when only the result of work is requested but not the way to achieve it, a blind user may choose a tool which is more feasible for him (if it exists). For example he can write a letter by use of a WYSIWYG publishing system, a graphic wordprocessor with layout control, a text based word processor or a text compiling system. The result is of nearly the same quality, but handling of fewer graphical tools is easier for a blind user.

Screen readers are highly dependent on the operating system. OS/2 is the only operating



system which is provided with a screen reader developed by the supplier. The PAL (Profile Access Language) is IBM's well defined interface to the off-screen-model. (<http://www.austin.ibm.com/sns>).

A large number of screen reader programs are developed for Microsoft Windows GUIs by specialised rehabilitation companies with a delay of up to two years. Their solutions differ very much in the strategy of transformation and presentation of information. These individual solutions often support only the vendor's own Braille displays or speech output devices.

This situation seems to be changing, because of exploding costs for development and support of screen readers with their increasing complexity and a decreasing number of installations of screen readers in the professional world due to unemployment.

The three most prominent screen readers will no doubt survive, supplied by specialised companies providing their solutions as a toolkit world wide to the established national distributors who do local and language support (including documentation), support of their Braille displays and speech synthesisers, training, and possible adaptation to a large variety of applications by developing suitable scripts. Perhaps this concentration will lead to cost reductions and hopefully closer co-operation between developers and the vendor of the operating systems together with a solution for new operating systems of Microsoft.

If these screen readers set a defacto standard for accessing Microsoft Windows, blind users can access any PC provided with the screen reader and Braille display and speech synthesiser like a sighted person does. Systems will still differ in the handling of the output devices, configuration of the applications, appropriate individual screen reader settings etc.

The work of a screen reader program can be improved by a well defined interface to the off-screen-model of the operating system and the applications themselves.

In 1998 Microsoft started to integrate MSAA (Microsoft Active Accessibility) into current operating systems and applications.

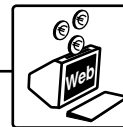
(<http://www.eu.microsoft.com/enable/msaa/default.html>, release 1.2.2, July 1999.) Active Access means, the programmer of an application may add additional text information to graphic elements and so the screen reader is enabled to ask for them. Applications which support MSAA recommendations are relatively easy to use by the blind, but most applications still ignore this enhancement. No company is forced to achieve better accessibility to their applications by MSAA. Many software developers don't know of MSAA.

Additionally software designers have their own vision of the look-and-feel of their products e.g. to establish the co-operate identity. They often use their own graphic libraries which do not support MSAA. This is extremely annoying for applications for which no alternatives are available. Examples include homebanking applications, applications for driving telephone switchboards, call centres, workflow management systems, etc.

For the GUI of Apple MAC OS there is currently no screen reader available. For the different window managers of Linux some research and development seems to be in progress. Probably the good access to the textual user interface which covers most functionality delayed this work. But with the rapidly growing propagation of Linux and suitable applications there is a very strong demand for a reliable screen reader for at least one window manager. The suppositions are very good, because basic research is done, the interfaces are well defined and the source is open. But currently there seems to be no funding for this complex software development.

In general, a platform and operating system independent definition of an off-screen-model would make screen readers, window-mangers and other nongrafical user interfaces independent from the underlying operating system. Such a standard would make development of screen readers much more efficient, because no special developements are needed for each operating system. But such a standard is not in the scope of providers of current operating systems.

Additionally, scripting languages for the configuration of screen readers are not



standardized. That means, scripts have to be developed for each screen reader and for each application.

For speech synthesisers some company specific interfaces are available which can be seen as defacto standards:

- SSIL (Speech Synthesiser Interface Library) V1.0 by Arkenstone (<http://www.arkenstone.org>)
- SAPI 4.0 (Microsoft Speech API) including speech recognition: (<http://www.microsoft.com/IIT/OnlineDocs/intro2SAPI.html>)
- JSAPI 1.0 (JAVA Speech API) including speech recognition: (<http://www.javasoft.com/products/java-media/speech/>)

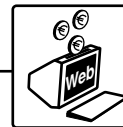
Other less popular interfaces are defined by several companies.

Braille displays differ in size, handling, hard- and software protocols which make them incompatible to each other. Even the character representation is rather different in most

European countries. Though all Braille displays support a user defined character set, this is an intolerable situation. Imagine, the ISO8859-1 character set would have different signs for most countries!

Computer Braille (DIN 32980) has been the first step to standardisation. For making the 8 dot Euro computer Braille an international standard, the blueprint of ISO CD 11548 was released in 1998. But there is has been no progress in standardisation up to now.

The usability of Braille displays is a new topic of development. The main task is to reduce the mechanical movement of hands and fingers between keyboard of the PC, Braille display and the keys for controlling the Braille display. While good solutions are going to the market, an opposite evolution takes place in the world of notebooks: Modern design has moved the keyboard from the leading edge to the trailing edge of the notebook to place the touch pad, speakers and handholds in front. But this maximises the mechanical distance between keyboard and the Braille display placed underneath the Notebook.



## Overview: Access to Different Operating Systems

	<b>Physically or Motor Impaired Persons</b>	<b>Strong Hearing Impaired or Deaf Persons</b>	<b>(Strong) Visually Impaired Persons</b>	<b>Blind Persons</b>
<b>DOS (Text and Graphic Mode)</b>	-Speech Recognition	- Special Applications	- Special Applications - Screen Magnifiers - Software Text to Speech	- Screen Reader (text mode only) - Software Text to Speech
<b>WIN 3.X WIN 9X WIN NT WIN 2000</b>	- Head and Eye Mouse -Speech Recognition (built in) - Input adaptation (built in)	- Optical Audio Signs (built in) - Special Applications	- Special Applications - Screen Magnifiers - Software Text to Speech	- Screen Reader - Software Text to Speech
<b>LINUX (Text and Graphic Mode)</b>			- Special Applications - Configuration of window managers	- Screen Reader (text mode only) - Software Text to Speech
<b>MAC OS</b>	-Speech Recognition		- Special Applications - Screen Magnifier - Software Text to Speech	
<b>OS/2</b>	-Speech Recognition (built in)		- Special Applications - Screen Magnifier - Software Text to Speech	- Screen Reader - Software Text to Speech
<b>OS independent</b>	- Special Keyboards and Pointing Devices		- Optical Vision Aid - Large TFT Monitor - Hardware Text to Speech	- Braille Displays - Hardware Text to Speech



## Access to the Internet

The World Wide Web Consortium (W3C) ([www.w3.org](http://www.w3.org)) is an international industry consortium carried by more than 350 members from leading companies, organisations and institutes around the world. Although W3C is funded by industrial members, it is vendor-neutral, and its products are freely available to all.

The W3C was founded in October 1994 to lead the World Wide Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability.

Other services provided by the Consortium include:

- a repository of information about the World Wide Web for developers and users
- reference code implementations to embody and promote standards
- various prototype and sample applications to demonstrate use of new technology.

The Consortium is jointly hosted by the Massachusetts Institute of Technology - Laboratory for Computer Science (MIT/LCS) in the United States, the Institut National de Recherche en Informatique et en Automatique (INRIA) in Europe, and the Keio University Shonan Fujisawa Campus in Japan, all three of which provide local support and perform core development.

The W3C was initially established in collaboration with CERN, where the Web originated, and with support from DARPA and the European Commission.

The Web Accessibility Initiative (WAI) ([www.w3.org/WAI](http://www.w3.org/WAI)) at the W3C addresses accessibility in the areas of technology, guidelines, tools, education & outreach, and research & development.

Even though the W3C seeks to promote standards for the WWW technologies and the WAI has strong mandate on making and keeping the Web accessible for all, nobody is forced to follow these jointly released standards.

Even members of the W3C extend defacto standards or modify them for their products to differentiate from competitors or even to be incompatible with them.

In addition, Internet technology is developing so rapidly, nobody will wait until a new standard is released by the W3C.

The market leaders often have the power to set up new defacto standards by their new products. In these cases so far, accessibility plays a minor role.

It is the freedom of the Web to follow the released accessibility guidelines of the WAI. And even those information providers willing to do so or forced by law (e.g. public institutions), have a major challenge to bridge the gap between attractive and thrilling Web sites and accessibility for all.

The Web Accessibility Initiative (WAI) addresses accessibility in different areas. Its International Program Office is supported in part by funding from about 10 organisations and company including the European Commission's DG XIII Telematics Applications Programme for Disabled and Elderly.

The Internet, in essence a visual medium, consists logically of two parts:

Servers which provide content in the HTML (Hypertext Markup Language) format and the browsers (or clients or agents) which run on the users computer, retrieve the content and present it to the user. The Internet is a so called pull medium: The user selects information and determines how long he will stay on this site. Therefore sites have to be exciting and that means graphic, motion, interaction, and sound. The Internet has moved rapidly from a simple information transport medium to a modern medium for advertisement, Electronic Commerce and communication. For these reasons, the primary used HTML is extended by several techniques like scripting, multimedia enclosures etc.

For an unaltered outfit of their sites, Web designers want to force the user to view their site with a certain browser. That means the



sites are specially constructed (and tested) for a certain browser version. Other browsers may render this site in another, unwanted way. On the other hand, designers like to present information as a picture, because pictures are presented by all browsers without modifications. This behaviour is completely in contrast to Web Accessibility.

## Web Content Accessibility

WAI's Web content accessibility guidelines 1.0 (5 May 1999) are a recommendation. (<http://www.w3.org/TR/WAI-WEBCONTENT>). They explain how to make Web content accessible and are intended for all Web content developers. However, following them will also make Web content more available to all users, whatever browser they are using (e.g. voice browser, mobile phone, mobile computer, etc.) or constraints they may be operating under (e.g. noisy surroundings, under- or over-illuminated rooms, in a hands-free environment, etc.). The guidelines do not discourage content developers from using images, video, etc., but rather explain how to make multimedia content more accessible to a wide audience.

## Clients

WAI's user agent accessibility guidelines 1.0 (28. Jan. 2000) are a candidate for recommendation. (<http://www.w3.org/TR/UAAG10>) They are designed to help developers understand and thereby reduce accessibility barriers that impede access to the Web. Though developers may believe that implementing accessibility features in their products is difficult or of limited use, considering accessibility during the design phase of a product leads to more flexible, manageable, and extensible software.

The guidelines include relevant information for a wide class of user agents: graphical desktop browsers, screen readers, speech synthesisers, multimedia players, text browsers, voice browsers, plug-ins, etc., with a particular focus on graphical desktop browsers and

The way to design thrilling and accessible sites is shown by the WAI in several documents donated to the different Web components and technologies. Of course, a large number of web accessibility guidelines can be found on the web. In principle they all are derived or covered by the WAI documents.

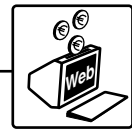
The following topics are explained in detail:

- Provide equivalent alternatives to auditory and visual content.
- Don't rely on colour alone.
- Use markup and style sheets and do so properly.
- Clarify natural language usage.
- Create tables that transform gracefully.
- Ensure that pages featuring new technologies transform gracefully.
- Ensure user control of time-sensitive content changes.
- Ensure direct accessibility of embedded user interfaces.
- Design for device-independence.
- Use interim solutions.
- Use W3C technologies and guidelines.
- Provide context and orientation information.
- Provide clear navigation mechanisms.
- Ensure that documents are clear and simple.

dependent user agents, which rely on other user agents for input and/or output. Dependent user agents include screen magnifiers, screen readers, alternative keyboards and pointing devices. The guidelines emphasise interoperability between these two classes of user agents.

The following topics are explained in detail:

- Support input and output device-independence.
- Ensure keyboard access to user agent functionalities.
- Provide accessible product documentation and help.
- Allow the user to configure the user agent.
- Allow the user to turn off features that may reduce accessibility.



- Ensure user control over document styles.
- Ensure user access to document content.
- Provide navigation mechanisms.
- Help orient the user.
- Notify the user of document changes.
- Support applicable W3C technologies and guidelines.
- Observe system conventions and standard interfaces.

Dependent user agents have the advantage that they will follow new internet technologies immediately, especially, when the necessary interfaces are build in. A very interesting alternative for visually impaired persons is a text browser which presents the content of Internet sites directly in a textual mode directly feasible for Braille display, speech synthesiser or text mode terminal. The big advantage is to leave

out the presentation layers of a GUI, the GUI screen reader and the browser interfaces. This requires a minimum of learning and supports even not Windows approved Braille displays. You need not buy an expensive new one. The Lynx browser (<http://lynx.browser.org>) is a widely used tool for the blind. It is available for most operating systems including DOS. The problem with this software is related to licensing proprietary internet technologies, and the voluntary developer community has not the power to follow new technologies within a short time. This extremely useful tool for the blind should be sponsored by funding development resources and some licensing problems (not technical but legal) should be cleared (for example the usage of RSA technologies outside the US).

## **Servers and Internet Service Providers**

Internet servers provide the content of Internet sites. In principle they are doing their job in the background and are invisible for the user. But sometimes they do not allow access for a browser they don't like! This may prevent people using text based browsers or voice browser. But in many cases there is really no reason for this exclusion.

There are some international Internet Service Providers (ISPs) which permit Internet access via their points of presence only by the exclusive support of their own software distribution. This is done by not using a standard connection protocol like PPP but a proprietary protocol. This might reduce support problems, but also excludes those people who are not able to use their software distribution. Users who need special browsers have to use other Internet Service Providers.

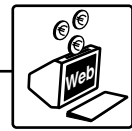
## **Authoring tools and Generators**

WAls authoring tool, Accessibility Guidelines 1.0 (3. Feb. 2000) are a recommendation. (<http://www.w3.org/TR/ATAG10>)

They are designed to help authoring tool developers understand, and thereby reduce, barriers to the creation of accessible Web content. The term authoring tool refers to the wide range of software used for creating Web content, including:

- Editing tools specifically designed to produce Web content (e.g. WYSIWYG HTML and XML editors).
- Tools that offer the option of saving material in a Web format (e.g. word processors or desktop publishing packages),

- Tools that translate documents into Web formats (e.g. filters to translate desktop publishing formats to HTML),
- Tools that produce multimedia, especially where it is intended for use on the Web (e.g. video production and editing suites, SMIL authoring packages),
- Tools for site management or site publication, including tools which generate Websites dynamically from a database, on-the-fly conversion and Web site publishing tools,
- Tools for management of layout (e.g. CSS formatting tools).



An accessible authoring tool is accessible software that produces accessible content for the Web. Because most of the content of the Web is created using authoring tools, they play a critical role in ensuring the accessibility of the Web.

The following topics are explained in detail:

- Support accessible authoring practices.
- Generate standard markup.
- Ensure that no accessibility information is missing.
- Provide methods of checking and correcting inaccessible content.
- Integrate accessibility solutions into the overall look-and-feel.
- Promote accessibility in documentation and help.
- Ensure that the authoring tool is accessible to authors with disabilities.

A lot of current accessibility problems would be solved by leading the user of authoring tools to a proper configuration. For example, most of the non English Web sites contain the language specification for English (default setting of authoring tools). Therefore this specification never can be used for a reliable language selection for speech synthesisers.

## ***Hypertext Markup Language and Style Sheets***

HTML is the publishing language of the World Wide Web. The latest version released by the W3C in December 1999 is HTML4.01 (<http://www.w3.org/TR/html401>). In addition to the text, multimedia, and hyperlink features of the previous versions (HTML2.0 released 1994, HTML3.2 released Jan.1996), HTML 4.0 (released Dec. 1997) and its successor HTML 4.01 support more multimedia options, scripting languages, style sheets, internationalisation of documents, better printing facilities, and documents that are more accessible to users with disabilities.

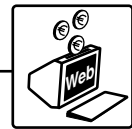
HTML 4.01 is an SGML (Standard Generalised Markup Language) application conforming to International Standard ISO 8879.

In addition to the more global "Web content accessibility guidelines" (chapter 13.3.1), WAI has published a specific document on "Accessibility Improvements in HTML4.0" in September 1999 (<http://www.w3.org/WAI/References/HTML4-access>) which also can be addressed to HTML4.01 and deals with:

- improved structure,
- style sheets,
- alternate content,
- easier navigation and orientation.

HTML was not designed with professional publishing in mind; it is intended to organise content, not present it. Consequently, many of the language's presentation elements and attributes do not always meet the needs of power page designers. To overcome layout limitations the task of presentation is assigned to style sheet languages which are fully integrated into html4.0. The CSS2 (Cascading Style Sheets, level 2) language was released by the W3C in May 1998 (<http://www.w3.org/TR/REC-CSS2>). It allows authors and users to attach style (e.g. fonts, spacing, and aural cues) to structured documents. By separating the presentation style of documents from the content of documents, CSS2 simplifies Web authoring and site maintenance. It supports media-specific style sheets so that authors may tailor the presentation of their documents to visual browsers, aural or Braille devices, handheld devices, etc. The specification also supports content positioning, downloadable fonts, table layout, features for internationalisation, automatic counters and numbering, and some properties related to user interface.

XHTML1.0, the Extensible HyperText Markup Language, is a Reformulation of HTML4.x in



XML 1.0 (s. below). It was released by the W3C in Jan. 2000 (<http://www.w3.org/TR/xhtml1>).

This is a big improvement because it not only guarantees backward compatibility to all HTML-documents but also brings the Web forward as an environment that better meets the needs of all its participants, allowing content creators to make structured data that can be easily processed and transformed to meet the varied needs of users and their devices. Both WAI's accessibility guidelines for HTML4.0 and XML1.0 will address XHTML1.0 accessibility. Probably WAI will work on a merged and improved accessibility guideline for XHTML1.0.

CSS2 benefits accessibility primarily by separating document structure from presentation. WAI has published a note on "Accessibility Features of CSS" in August 1999 (<http://www.w3.org/TR/CSS-access>) which summarises the features of CSS2 known to directly affect the accessibility of Web documents:

- reduction of HTML element and image misuse,
- precise control over font size, colour, and style, spacing, alignment, and positioning,
- allow users to override author styles,
- support for automatically generated numbers, markers, and other content that help users stay oriented within a document,
- support of aural style sheets, which specify how a document will sound when rendered as speech,
- precise control over the display of alternative content.

Currently, widely deployed browsers do not implement CSS2 consistently. Therefore there is no experience available. This potentially promising way highly depends upon the proper implementation of Web authors.

Multimedia presentations rich in text, audio, video, and graphics are becoming more and more common on the Web. The SMIL (Synchronised Multimedia Integration Language 1.0) was released by the W3C in June 1998 (<http://www.w3.org/TR/REC-smil>) and allows integrating a set of independent multimedia

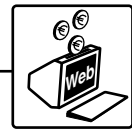
objects into a synchronised dynamic multimedia presentation. Using SMIL, authors can:

- describe the temporal behaviour of the presentation,
- describe the layout of the presentation on a screen,
- associate hyperlinks with multimedia objects.

WAI has published a note on "Accessibility Features of SMIL" in September 1999 (<http://www.w3.org/TR/SMIL-access>) which focuses on SMIL1.0 features helping to create accessible presentations. Dynamic multimedia presents a number of challenges to people with disabilities and to authors of accessible content:

- Authors must provide alternative equivalent content to audio and video. Text content is most valuable.
- Alternatives to video and audio content must be synchronised with video and audio tracks. Improperly synchronised alternatives may be so confusing as to be unusable.
- A presentation may occupy multiple sensory channels in parallel. Any content that is presented to a given sense must be coordinated to ensure that it remains intelligible when rendered with other content meant for that sense.
- The very nature of synchronised multimedia, content changes without user interaction, poses an orientation challenge to users who are not able to access the information in the predefined time interval. They may still access a presentation as long as the author has provided adequate alternatives and players allow sufficient control over the presentation.

The XML (Extensible Markup Language 1.0) was released by the W3C in February 1998 (<http://www.w3.org/TR/REC-xml>). It is a meta-syntax, used to declare grammars (called DTDs - Document Type Definition) for new computer languages and formats (called markup). DTDs can be used in two ways:



- Machine-centric: The content being marked up is only for machine consumption.

- User-centric: For user interface oriented structural textual rendering (e.g. HTML) or specialised rendering (e.g. VRML). XML is a subset of SGML. Its goal is to enable generic SGML to be served, received, and processed on the Web in the way that is now possible with HTML.

WAI has published a draft note on "XML Accessibility Guidelines" in September 1999 (<http://www.w3.org/WAI/PF/xmlgl.htm>) which deals with the user-centric part of XML and provides guidelines for new DTD/Schema/Profile designers and editing tool developers. In general:

- An XML DTD is accessible if it enables and promotes the creation of accessible documents.
- A document is accessible if it can be equally understood by its targeted audience regardless of the device used to access it.

Guidelines for designers for creating user interface oriented XML DTDs are:

- follow general principles of separation of structure/content and presentation,
- enable text-only presentation of your documents,
- provide rich native structural/navigational constructs,
- provide atomic semantic markup,
- support a key-based (discrete) input model.

XSL (Extensible Stylesheet Language) is a language for expressing stylesheets. It consists of:

- a language for transforming XML documents, and
- an XML vocabulary for specifying formatting semantics.

An XSL stylesheet specifies the presentation of a class of XML documents by describing how an instance of the class is transformed into an XML document that uses the formatting vocabulary. The XSL specification is a working

draft published in April 1999 by the W3C (<http://www.w3c.org/Style/XSL>).

Accessibility features are still missing in current XSL specifications but the results of the meta language should follow in principle the intention of the accessibility guidelines for CSS.

Examples for XML DTDs are:

- VRML: (Virtual Reality Modelling Language) Unfortunately access hooks such as alternative text nodes were not included in the VRML 2.0 specification (VRML'97, ISO/IEC 14772-1) ([http://www.vrml.org/fs\\_specifications.htm](http://www.vrml.org/fs_specifications.htm)). As discussion continues on how VRML should evolve, the Centre for Academic and Adaptive Technology (CAAT) will advocate the inclusion of access hooks in subsequent standards so information presented in a VRML environment can be accessible. The organisation now responsible for creating the next VRML standards is the Web3D Consortium (<http://www.web3d.org>).

- MusicML: (Music Markup Language) The "Connection Factory" has implemented Sheet Music just for studies on XML (<http://195.108.47.160/3.0/musicml/index.html>). It is an interesting approach for presenting music notes. Perhaps this can be developed as a substitute for notes presentation in Braille printing which differs - for historical reasons - in its coding from country to country. Accessibility features are not mentioned in MusicML up to now.

- SVG: (Scalable Vector Graphics 1.0) SVG is a language for describing two-dimensional vector and mixed vector/raster graphics in XML. The working draft was published in August 1999 by the W3C (<http://www.w3.org/TR/SVG>). Appendix E of the SVG specification deals with accessibility support.

- MathML: (Mathematical Markup Language 1.01) MathML is a low-level specification for describing mathematics as a basis for machine to machine communication. It provides the inclusion of mathematical expressions in Web pages. MathML is intended to facilitate the use and re-use of mathematical and scientific content on the Web, and for other applications



such as computer algebra systems, print typesetting, and voice synthesis. MathML can be used to encode both the presentation of mathematical notation for high-quality visual display, and mathematical content, for applications where the semantics plays more of a key role such as scientific software or voice synthesis. The W3C has released MathML 1.01 in July 1999 (<http://www.w3.org/TR/REC-MathML>). Accessibility features are directly integrated ("Design Goals of MathML" chapter 1.2.4). Perhaps MathML can be developed as a substitute for mathematic presentation in Braille printing which differs - for historical reasons - in its coding from country to country and even in the same country. This is a unacceptable situation.

- **VoiceXML:** (Voice eXtensible Markup Language) The VoiceXML (formerly VXML) specification is expected to simplify creation and delivery of Web-based, personalised interactive voice-response services and enable phone and voice access to integrated call center databases, information on Web sites, and company intranets. The VoiceXML specification also will help enable new voice-capable devices and appliances. More than 40 leading companies joined the VoiceXML forum and have contributed their work "PhoneML", "SpeechML", and "VoiceML" to create an open specification. The forum has published its preliminary specification for VoiceXML 0.9 in August 1999 (<http://www.voicexml.org>). Voice implies a kind of accessibility and this is perhaps the reason no special accessibility features are mention in the VoiceXML specification.

## Scripting and programming languages

The Common Gateway Interface (CGI 1.1) is a standard for interfacing external applications with information servers, such as Web servers. A plain HTML document is static, which means it exists in a constant state and doesn't change. A CGI program, on the other hand, is executed in real-time, so that it can output dynamic information e.g. from a data base query. A CGI program can be written in any language that allows it to be executed on the server, but scripting languages are preferred.

A script is a sequence of instructions that is interpreted or carried out by another program rather than by the computer processor. In the context of the World Wide Web, Perl (Practical Extraction and Reporting Language), VBScript (Visual Basic Script), AppleScript, TCL (Tool Communication Language), and similar script languages are designed to handle forms or other services for a Web site and are processed on the Web server. Therefore they are called Servlets.

PHP3 (Personal Home Page Tools) (<http://www.php.net>) is a script language and interpreter, that is freely available and used primarily on Linux Web servers. The PHP script is embedded within a Web page along with

its HTML. Before the page is sent, the Web server calls PHP to interpret and perform the operations called for in the PHP script. Like ASP (s. below), PHP can be thought of as dynamic HTML pages, since content will vary based on the results of interpreting the script.

All programs executed on the Web server provide HTML documents. These dynamically generated documents should of course fulfill the same Web accessibility requirements as static documents.

The scripting language JavaScript can be run at the server as in Microsoft's Active Server Pages (ASPs). But most times it is embedded in HTML pages and interpreted by the Web browser to achieve interaction and minimise traffic.

Some examples:

- Automatically change a formatted date on a Web page,
- Cause a linked-to page to appear in a popup window,
- Cause text or a graphic image to change during a mouse rollover,
- Check users form entries before sending them.



Both Microsoft and Netscape browsers support JavaScript, but sometimes in slightly different ways. Currently there is no support of JavaScript in special browsers like Lynx, because it is not easy to find adequate textual presentations for the primary graphic facilities. Some work on this is in progress.

JavaScript uses some of the same ideas found in Java, the compiled object-oriented language derived from C++. A Java applet is a small program that is sent as a separate document along with a Web (HTML) page. Java applets can perform interactive animations, immediate calculations, or other simple tasks without having to send a user request back to the server. Currently there is no support of Java applets in special browsers like Lynx, because it is not easy to find adequate textual presentations for the primary graphic facilities.

Java applications (<http://www.java.sun.com>) run on a wide variety of host operating systems, many of which already have assistive technologies available for them. In order for these existing assistive technologies to provide access to programs written in the Java programming language, they need a bridge between themselves in their native environments and the Java Accessibility support that is available from within the Java virtual machine (Java VM). This bridge, by virtue of the fact that it has one end in the Java VM and the other on the native platform, will be different for each platform it bridges to. Sun Microsystems Inc. is currently developing both

the Java programming language side of this bridge, and the Win32 side and intends to make similar bridges available for other platforms over time.

The JAVA Accessibility Interface, API (<http://www.sun.com/products/jfc/jaccess-1.2/doc>) provides a clean interface that allows assistive technologies to interact and communicate with the JFC (JAVA Foundation Classes) and the AWT (Abstract Window Toolkit) components. Development of this API has followed an open design process.

The unparalleled accessibility built into the JFC software makes it possible for software vendors to satisfy accessibility needs. Analogous to MSAA, the software providers are responsible for using these excellent features.

The Java Speech Markup Language (JSML, 0.5, august 1997) (<http://www.javasoft.com/products/java-media/speech/forDevelopers/JSML>) is used by applications to annotate text input to Java Speech API speech synthesisers. The JSML elements provide a speech synthesiser with detailed information on how to say the text. JSML includes elements that describe the structure of a document, provide pronunciations of words and phrases, and place markers in the text. JSML also provides prosodic elements that control phrasing, emphasis, pitch, speaking rate, and other important characteristics. Appropriate markup of text improves the quality and naturalness of the synthesised voice.

## **Wireless Application Protocol**

The WAP 1.1 (<http://www.wapforum.org>) is an open, global specification for a set of communication protocols to standardise the way that wireless devices can be used for Internet access, including e-mail, the World Wide Web, newsgroups, and Internet Relay Chat (IRC).

The WAP Forum is the industry association comprising over 200 members that has developed the de-facto world standard for wireless information and telephone services. The WAP 1.2 specification is under

development. This chapter will only focus on WML (Wireless Markup Language), formerly HDML (Handheld Devices Markup Language), which is a language that allows the text portions of Web pages to be presented on cellular phones and Personal Digital Assistants (PDAs) via wireless access. WML is based on XML and is intended for use in specifying content and user interface for small narrowband devices. The resulting constraints are:



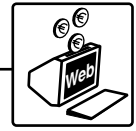
- Small display and limited user input facilities,
- Narrowband network connection,
- Limited memory and computational resources.

And indeed, these restrictions result from a kind of disability. Small displays and narrowband networks force content providers to design their information in a proper way:

- focus on the real information,
- easy navigation,
- no redundant information,
- good structure of information,
- simple layout,
- hard restriction on the usage of images and multimedia,
- restricted user interaction.

These requirements are obviously matching the recommendations of the Internet access guidelines (chapter 13.3.1) perfectly. Disabled

persons may have problems in using mobile handheld devices. But it is a very promising idea to retrieve information in WML format via Internet and present them on a computer with a special browser or with the help of the normal Internet browser which uses a WML-to-HTML proxy or filter. The advantage of this is clear: WAP compatible content will grow rapidly with the implementation of WAP services and the availability and market acceptance of WAP devices and, because of the restriction of the devices, an easy access to WML documents is enforced. Information providers will have to create accessible sites in HTML, for all users of WAP devices, not just for a minority of disabled users! And they will be able to review their design immediately by using WAP devices themselves.



## Access to E-Commerce

An important factor in the growth of the Web is E-Commerce (Electronic Commerce, EC) or E-Business: The ability to buy, sell, and advertise goods and services to customers and consumers.

The Global Business Dialogue on Electronic Commerce (GBDe) forum (<http://www.gbde.org>), launched in 1998, consists of several hundred of leading companies and trade associations. At the GBDe conference in September 13, 1999 world business leaders for the first time agreed on the fundamental principles of global electronic commerce:

- authentication and security,
- consumer confidence,
- content and commercial communications,
- information infrastructure,
- intellectual property rights,
- jurisdiction,
- liability,
- protection of personal data, and
- taxes and tariffs.

These recommendations are a very important step, but statements on accessibility, barrier free E-Commerce (for disabled people) or social responsibility are not mentioned.

Also the W3C is concerned with the evolution of the medium itself. The Electronic Commerce Interest Group (<http://www.w3.org/ECommerce>) has started activities to understand the problems and work with W3C members to contribute to the solutions. They focused their work on protocols like micropayment, etc. The needs for accessibility are not pointed out to now.

### **E-Commerce includes:**

- E-tailing (online retail selling) or virtual storefronts on Web sites with online catalogues, gathered into a virtual malls,
- the gathering and use of demographic data through Web contacts,
- Electronic Data Interchange (EDI), the business-to-business exchange of data,

- E-mail and fax and their use as media for reaching prospects and established customers (e.g. newsletters),

- Including buying and selling,

- the security of business transactions.

This chapter will focus only on the consumer accessibility aspects of E-commerce, not on things like protocols (e.g. micropayments, cryptography) which does not affect user interfaces directly.

From the users point of view, the Internet browser is the tool for visiting online shops. Although the Web sites advertise the products and their providers by the usage of all Internet facilities, these sites should follow the accessibility guidelines (chapter 13.4.1, 13.4.5). This is an evident recommendation but today's designers of virtual market places feel thrilling presentations and accessibility are mutually exclusive, but a minority of providers demonstrate that this is not true!

Virtual market places are often coupled with data bases and there Web presentation is done by generator and authoring tools and scripting (chapter 13.3.4, 13.3.6). Scripting on the client site causes some problems for disabled users. Therefore it is very helpful, if interaction is also provided (perhaps as an alternative) without usage of JAVA Script or JAVA Applets or certain plugins. Most special browsers do not support these techniques, and therefore encryption based on these techniques is not possible. Security via build-in SSL (secure socket layer) is currently not supported by all special browsers (chapter 13.3.2) for juristic reasons (US export control) but a practicable way.

New protocols for E-Commerce, e.g. payment, micropayment, authentication, HBCI (Home Banking Computer Interface) etc. have to be open to all so that they can be implemented into non mainstream browsers.

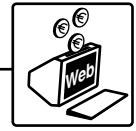
Conferencing tools, tools for voice-over-IP (Internet telephone) and applications for business-to-business buying, selling and data interchange are based on the standard Internet



protocols. These applications should be accessible for disabled persons (chapter 13.2). The accessibility recommendations are also applicable to helper tools like mediaplayers (shockwave, mpeg, quicktime, Real Audio) or mail clients etc. In this context Internet homebanking applications cause a lot of trouble for blind users. As they are designed for a specific browser and operating system and

provide a very specific graphical user interface without MSAA support, current solutions are not feasible for the blind.

The old BTX based homebanking solution, a favourite of blind users because of its textual user interface, is no longer supported. An equivalent substitute based on Internet technology is not available.



## Conclusion

This chapter has noted today's solutions and problems of disabled persons for accessing the Internet and E-Commerce and as a precondition the general access to computers.

At the exhibition "Reha International" (November 1999) - the most important international forum for people with special needs - current solutions for computer access were presented. It appeared, especially for the visually impaired users, that solutions for accessing mainstream operating systems and applications are available in about two years time. The number of bridge software solutions (screen readers) will decrease and the dominance of two or three products is obvious. Considerable problems come from graphical applications which present information in a graphical way only and do not support accessibility techniques like MSA or even simple things like colour settings or configuration of the screen layout. Such applications are major barriers to visually impaired persons. The techniques for making even special applications accessible are well known, but only a few user interface designers are willing to support them. The reasons for this may stem from ignorance/ unawareness, and increasing software development costs and / or misunderstanding guidelines.

And when software is declared "accessible" by the creator, this is perhaps true in his mind but not approved by the handicapped users. A certification of accessible software by a neutral institution with high experience in assistive technologies and with disabled employers who judge software from the point of own experience may be considered a possible solution.

Additionally laws can enforce accessibility of software, the Internet and E-commerce. On the basis of the US "Americans with Disabilities Act" (ADA, 1990) in November 1999 the National Federation of the Blind sued America Online inc. for Internet services that were inaccessible to the blind.

But laws and regulations are not a perfect solution, because it takes a long time and money to enforce them in one country only.

But software and the Internet are international

and fast moving media. Although, accessibility guidelines for the Internet and indirectly E-commerce are well defined by the WAI, nobody is forced to follow them. Public institutions are often forced to make their Internet sites accessible, and the results are of more or less good quality. But everybody may create his or her own Web site. How to force persons, companies and institutions to take care of accessibility, is an unsolved problem. Public relations of the WAI and many other national and international interest groups are well done since years and led to a minimum of awareness and sensibility. A promising possibility is to make the Internet more accessible by construction by separating document structure from presentation in HTML4, CSS2 or XHTML1.0. It is the daily experience of the blind author of this chapter to visit Web sites which are more or less accessible or even completely inaccessible (e.g. documents in a graphic format), also in the context of research for this article.

In this article, many upcoming technologies and their accessibility features are described. Comparing this with the solutions presented at the REHA exhibition, there seems to be a wide gap between design of solutions and their practical implementation..

New operating systems will be much more graphically orientated, Internet presentation will go more in the direction of multimedia and virtual reality, and E-Commerce will grow very rapidly. We have to make these technologies accessible to all users and not just for a majority of users. We have to remind main players not to only focus on those user groups they expect most commercial success from. They should also have a look on the group of disabled and elderly persons as they are groups with the most important benefit from the Internet and E-Commerce. Doing so, shows the social competence of those companies.