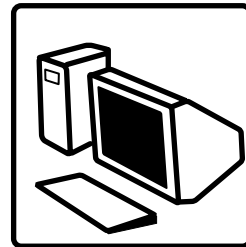
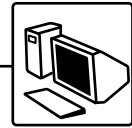


Chapter 10

Personal Computers





Contents

Introduction	10-2
Standards	10-3
Output from Projects	10-5
User Requirements	10-6
Conclusions	10-20

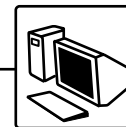
Introduction

The term "personal computer" is normally used for single-user desktop and portable workstations based on single-user operating systems, and used for office and home applications. There are other single-user workstations based on multi-user operating systems, mostly of the UNIX-type. Such workstations are commonly known as high-performance workstations and are used for technical computations, CAD/CAM, software development and other applications requiring high computational power. This section is limited to the personal computer in its first mentioned, normally used sense. It should however be recognised, that the boundary between low-end workstations and high-end personal computers is blurred.

Personal computers for professional and private use are dominated by one technical platform, the Microsoft Windows family of operating systems. (Sometimes the term "PC" is used for personal computers in general, sometimes it is used for what was formerly known as "IBM-compatible PCs". PC is originally a brand name for the first personal computer marketed by IBM). It is estimated that this platform comprise approximately 90% of the installed base. The main competing platform is the operating system of Apple. Another platform, currently increasing its market share, is Linux. However, none of the members of ICT Standards Board is involved in

making specifications, relevant for consumers, for any of the platforms Windows, Apple or Linux.

What will be the future of the current desktop PC? Will it be replaced by mobile telephones and other, not yet developed small handheld communication devices? A reasonable prediction is that the typical desktop PC will survive for many years. Another reasonable prediction is that the market segment of laptops and notebooks will merge with the segment of mobile telephones. A continuum of products will emerge, from the portable variant of the office PC, over the handheld communication terminal with web browser, e-mail, fax and telephony, to the single-functional mobile telephone.



Standards

Standards of the basic personal computer

The PC is standardised by market dominance of Intel and Microsoft, not by standardisation work of formal standards bodies or industry fora. Intel and Microsoft jointly produces annual specifications, which serve as references for PC hardware, firmware and device manufacturers. The current specification is PC 99 System Design Guide, A Technical Reference for Designing PCs and Peripherals for Microsoft Windows Family of Operating Systems. PC 99 make references to existing industry standards or specify performance goals or benchmarks rather than prescribing fixed hardware implementations. Examples of standards and specifications referred to are:

- ECMA standards for DVD disc drives,
- IEEE 1394 Bus standards,
- Control IR Specifications by the Infrared Data Association (IrDA),
- ISO/IEC 7816 Identification Cards,
- PCMCIA PC Card specifications,
- SCSI specification,
- USB (Universal Serial Bus),
- ITU Recommendation V.18,
- Display Data Channel specified by the Video Electronics Standards Association (VESA).

Furthermore, The PC Design Guide refers to some ergonomic and environment specifications, such as

- IEC and ANSI safety considerations for computers, networks and consumer electronic devices,
- The Storage Device Class Power Management Reference Specification, Version 1.0 or later.

Appendix C of PC99 is a guide with recommended accessibility features supported by the Windows family of operating systems. These guidelines were developed in consultation with the Trace Research and Development Center at the University of Wisconsin, USA, and were based on research funded by the National Institute for Disability and Rehabilitation Research (NIDRR). The

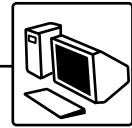
guidelines are recommendations and will not be made mandatory.

A similar guide is Nordic Guidelines for Computer Accessibility (1998), Second Edition, produced and published by Nordic Cooperation on Disability. The intended users are ICT strategists, purchasers, standardisers, developers and manufacturers. It presents a set of functional requirements which meet the need for accessibility of personal computer systems operated by the end-user. It is intended to be platform and vendor independent.

The Spanish standards body AENOR has adopted a national standard "Health informatics. Computer Applications for people with disabilities. Accessibility requirements for computer platforms". The standard has two parts, one (UNE 139801 EX) for hardware, one (UNE 139802 EX) for software.

The accessibility of an ICT system is to a great extent determined by the accessibility features of the user interface, the man-machine interaction. The major standard on man-machine interaction is ISO 9241: Ergonomic requirements for office work with visual display terminals. This standard is a multi-part standard for ergonomic requirements for hardware and software of computer-based office systems. The standard covers requirements on visual display units, keyboards, pointing devices, workstation layout, dialogue principles, presentation of information, design and evaluation of user guidance attributes, menu and command language dialogues, form filling etc. Although made for office applications and skilled workers, the standard may be applicable also for systems aimed for occasional, non-skilled users.

At present (March 2000), ISO 9241 does not address accessibility. However ISO TC159 (Ergonomics) is preparing a technical specification on software accessibility, ISO TS 16071, intended to be supplementary to ISO 9241. The purpose of the specification is to provide guidance on how to design software



which allows it to be used by as wide an audience as possible, minimising the use of assistive software and hardware, although supporting the use of these when necessary.

For standards related to web pages, please see chapter 13.

Connection of assistive devices

Assistive devices can be connected by

- plug-in to the serial port,
- plug-in to the parallel port,
- expansion slot,
- infrared technology,
- radio transmission.

The PC 99 Design Guide specifies six bus technologies: USB (Universal Serial Bus), IEEE 1394, PCI, ATA and ATAPI, SCSI and PC Card.

USB provides an expandable Plug and Play serial interface that intends to ensure a standard, low-cost socket for adding external peripheral devices ranging from interactive devices such as joysticks and pointing devices to isochronous devices such as telephony, audio, and imaging devices. The current ISA bus with ISA expansion slots are expected to be eliminated in the PC99 time frame and replaced by the USB. USB is required on all PC 99 systems, and migration of I/O devices from legacy ports, such as ISA, to USB is recommended by the PC 99 Design Guide.

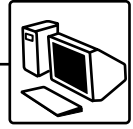
In particular, the joystick, pointing device, and keyboard devices that ship with PC systems should be USB. It should be noted that USB and MS-DOS do not support each other. MS-DOS is still used by many blind persons because of the easy access to the textual interface.

For infrared technology, PC99 encourages designers to use the IrDA Data and Control protocols, arguing that the IrDA Control protocol has some significant advantages over the legacy remote control protocols that give it the potential to become a world-wide standard.

Standards groups for radio frequency communications are emerging. Two major specifications are HomeRF and Bluetooth, both supported by most major telecom and computer manufacturers. Microsoft supports only HomeRF and the PC99 recommends it for use. On the other hand, Intel joined the Bluetooth consortium from its start.

Speech synthesizers and speech recognition are frequently used as assistive technologies. They are expected to become standard features of personal computers, provided however that the technology is available for different languages. Proprietary specifications are available:

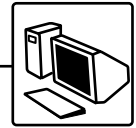
- SSIL (Speech Synthesizer Interface Library) V1.0 by Arkenstone,
- SAPI (Microsoft Speech API),
- JSAPI (JAVA Speech API).



Output from Projects

TIDE Bridge Phase Project 1001, ACCESS
ACCESS resulted in a technical platform for development of user interfaces and software tools for construction of interfaces adapted to particular user abilities, needs and preferences. ACCESS was completed in 1996. The ACCESS consortium proposed a New Work Item in ISO TC 159 SC4 on accessibility. This became the current work on software accessibility, based on previous work in ANSI. The ACCESS consortium is currently preparing proposals for work items based on ACCESS results.

Telematics Application Project TE 2010 RESPECT
RESPECT has produced a report "Requirements and evaluation for people with special needs". It focuses on human characteristics (vision, hearing, cognitive abilities, mobility and dexterity, old age and young age) and gives, inter alia, requirements on ICT applications related to the different characteristics and within the concept of Universal Design. In addition, the report provides advice on commonly used methods for evaluating prototype systems to ensure that the user requirements have been met.



User Requirements

The Technical Platform



Home



Professional



Mobile Environment

- The term "technical platform" is here meant to be a combination of components such as processor, operating system, network services, programming languages, database management etc., which are standardised or market leading.
- To maximise system accessibility, the platform should comply with the principles of open systems and allow that interoperable, compatible and portable standard application programs, company-specific application programs, and assistive software to be installed and executed. The platform should include as many features as possible which promote accessibility, thus providing the programmer with building blocks with intrinsic accessibility features. A special advantage is that this will facilitate development of assistive software with common user interface and behaviour, which promotes portability and compatibility. Assistive devices could easily be exchanged or upgraded when necessary.

Requirements

Standardisation



Physical

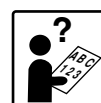
- | | |
|--|--|
| <ul style="list-style-type: none"> - The user interface should be customisable. - Users should have keyboard access to all commands and options. - Users should be enabled to select the output mode of the information according to their abilities and preferences. | <ul style="list-style-type: none"> - Major operating systems have a set of built-in accessibility features. For example, the features for modifying the keyboard behaviour ("Sticky keys", "Bounce keys" etc) are implemented in MS-DOS, Windows, OS/2, X-Windows, MacOS and some UNIX-implementations. - There is a limited need for increased unification of the major operating systems as regards the built-in accessibility. Windows dominates heavily, and people seldom move between different platforms. It is better to promote increased provision of flexibility and personalisation, however with easy-to-use parameter setting. |
|--|--|



Auditory



Visual



Cognitive

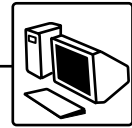


Dexterity



Combination

- Same as physical



The System Unit and other Hardware Components



Home



Professional



Mobile Environment

- The user must be able to connect the peripherals, assistive devices and assistive software needed to compensate for the specific disability. Interoperability, compatibility and portability between system parts must be ensured by means of open standards.

Requirements

Standardisation



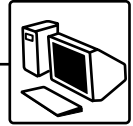
Physical

- Serial and parallel interface connectors, data buses, keyboard connectors and other data transfer mechanisms such as infrared technology or radio, should follow existing standards or widely recognised technical specifications.
 - In the authorisation process, allowing the user access to programs and data, different technical solutions for identification and identity verification should be allowed. The technical solution of the security system must not require modification of the standard input/output devices of the workstation.
 - There is a need for open and modular solutions, where a security system can be introduced or replaced without the need for changing an assistive device, and vice versa.
 - Card systems should be easy to use for people with reduced visual or mobility abilities. Swipe readers should be avoided. Preferably, contactless systems should be used.
- For the Windows operating systems, Intel and Microsoft jointly produces annual design guides for PC manufacturers. They include requirements on data buses and other connectors, and are market leading specifications.
 - This is an issue of standardisation of interfaces between the host system, the security system and the assistive device/software.
 - For standardisation of card system, see chapter 12.



Auditory

- Same as physical.
- The electromagnetic characteristics of the equipment should not generate interference for a user with a hearing aid where the induction pick-up coil is activated.
- A global standard on acceptable levels and measurement methods is required.



Requirements

- The noise from the fan, the harddisc, or the printer should be minimised, since it may be annoying for a hearing impaired person, since it interferes with the conversation in the room.

Standardisation

- This is a general consumer concern. A global standard on acceptable levels and measurement methods would substantially facilitate purchaser and consumer choices.
- IEC TC74 has attempted to produce requirements for acoustic safety applicable to ICT equipment. However, no agreement was made, and neither IEC TC74 nor CENELEC TC74 are currently active in this field. ETSI is currently discussing whether it should produce such a standard specific for telecommunication equipment or leave the matter to CENELEC as a general issue.



Visual



Cognitive

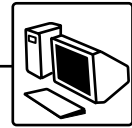


Dexterity



Combination

- Same as physical.



Controls - Finding, Reaching, Identifying, Using



Home



Professional



Mobile Environment

- People who have limited range, reduced strength and reduced precision in their movements may have a reduced ability to operate controls such as turn knobs and twist mechanisms. These people, and most other people, prefer front-placed push buttons and sliding mechanisms. Visually impaired persons may have difficulties in finding and identifying certain controls, as well as perceiving how a control is adjusted. Consequently, controls such as push buttons, switches, latches, control knobs etc., should be easy to reach, find, identify and use. In all cases, adjustment states should be easily perceivable.

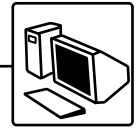
Requirements

Standardisation



Physical

- The surface of the controls should not contain chromium, nickel or other material which may cause allergy.
 - Controls should be placed so they could easily be reached by, for example, a short person or a person sitting in a wheelchair.
 - Controls should be placed separate from each other, to be easy to grasp and to avoid confusion.
 - Controls should be placed so that they are not activated by mistake.
 - Controls should be marked so that the control setting can be easily identified by touch.
 - The adjustment settings should be easily perceived.
 - The size, shape and surface of controls should be designed so that they are easily grasped when they are used as intended.
 - No operation of a control should require more power than 2 Newton.
 - Mechanisms for opening up and shutting by latches (for example laptop computers) should not require simultaneous use of two hands.
- There are two aspects on standardisation of controls: design and location. As regards design, this is an issue for any device, not only computers. There are guidelines on design of consumer products, e.g. by Trace Center, which covers manipulation of knobs, thumbwheels etc. As regards location, there seems to be no standard on where to locate various controls on a system unit, display unit, printer etc. Frequently used solutions, e.g. the touch controls for controlling the screen shape of a CRT display unit, seem to be the result of the market forces.



Requirements

Standardisation

- Mechanisms for inserting and removal of diskettes, CD discs and similar storage media should require a minimum of muscular strength, range of motion, reach and movement precision. Twist lock mechanisms should be avoided.
- Diskette units should pop out the diskette so that it can be easily grasped. It is desirable that this can be controlled by the software.



Auditory

- None identified



Visual

- Controls should be placed separate from each other, to be easy to grasp and to avoid confusion.
- Controls should be placed so that they are not activated by mistake.
- Controls should be marked so that the control setting can be easily identified by touch.
- The adjustment settings should be easily perceived.
- Same as for physical.



Cognitive

- None identified.



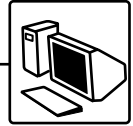
Dexterity

- Same as physical.



Combination

- Same as for physical.



The Perception of Alarms, Warnings, Status Signals, Error Messages



Home



Professional

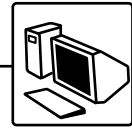


Mobile Environment

- Signal lamps are often used to show if a function is switched on or off, for example the Caps Lock key. Visually impaired persons require such information presented in other ways, either by touch or audibly. Visually impaired persons are also not able to perceive error messages appearing on displays.
- Many programs make use of a sound to notify the user of a warning or that an error has occurred. A person with a hearing impairment needs to be informed visually. Visually presented alarms should appear for a sufficiently long time to maximise the possibilities of the user noticing the signal.

Standardisation

- These issues are discussed in the ongoing work in ISO TC159 on ISO TS 16071, Accessibility of software.



The Use of Keyboards

Requirements

Standardisation



Physical

- The user should be allowed to customise the keyboard with respect to features such as repeat rate, key activation delay, delay between acceptance of two consecutive key presses, minimum time for pressing a key before the key repeat begins, and serial instead of multiple simultaneous keystrokes etc.
 - If sufficient space is available, shift keys (upper and lower case, ctrl, alt etc.) should be duplicated, one on each side of the keyboard, and be placed symmetrically.
 - The keyboard should be designed to provide sufficient space to allow the user to mount a keyguard.
 - The system should allow the connection of two keyboards, which could be used simultaneously, for instruction purposes.
 - The power needed to press a key should be between 0.3 and 0.6 Newton. Preferably, the required power should be adjustable.
- Keyboard design and keyboard layout is standardised in ISO 9241-4 and ISO 9995.
 - The issue of customising keyboard features is discussed in the ongoing work in ISO TC159 on ISO TS 16071, Accessibility of software.



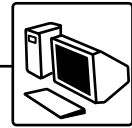
Auditory

- None identified.



Visual

- Groups of keys (alphanumeric, numeric, function keys) should be separated by distinct spaces, with a distance of at least half a key. (This requirement is not applicable on laptops.)
- Groups of keys should be distinguished by different colours on the key tops, but in a way that colour-blind persons may discern the colours.



Requirements

Standardisation

- The F and J keys on the alphanumeric keyboard, and the 5 key on the numeric keyboard, should be marked with a tactile identification, preferably in the form of a ridge on the keytop edge nearest to the user.
- Frequently used keys, such as ENTER, SHIFT, ESCAPE, CTRL, BACKSPACE etc., should be placed and have a shape that differ from other keys so that they are easy to find.
- The contrast between the colours of the characters and the background of the keytop should be the best possible.
- The height of the characters of the alphanumeric and numeric keys should not be less than 4 mm.
- The height of the characters of the other keys should not be less than 4 mm, if there is available space.
- The text on the keys should be printed in sans-serif characters, which is considered to be more easy to read than other typefaces.
- No text should be printed in red or green colour.



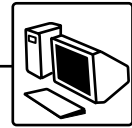
Cognitive

- None identified.



Dexterity

- The user should be allowed to customise the keyboard with respect to features such as repeat rate, key activation delay, delay between acceptance of two consecutive key presses, minimum time for pressing a key before the key repeat begins, and serial instead of multiple simultaneous keystrokes etc.



Requirements

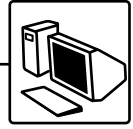
Standardisation

- If sufficient space is available, shift keys (upper and lower case, ctrl, alt etc.) should be duplicated, one on each side of the keyboard, and be placed symmetrically.
- The keyboard should be designed to provide sufficient space to allow the user to mount a keyguard.
- The system should allow the connection of two keyboards, which could be used simultaneously, for instruction purposes.
- The power needed to press a key should be between 0.3 and 0.6 Newton. Preferably, the required power should be adjustable.



Combination

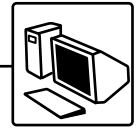
- Groups of keys (alphanumeric, numeric, function keys) should be separated by distinct spaces, with a distance of at least half a key. (This requirement is not applicable on laptops.)
- Groups of keys should be distinguished by different colours on the key tops, but in a way that colour-blind persons may discern the colours.
- The F and J keys on the alphanumeric keyboard, and the 5 key on the numeric keyboard, should be marked with a tactile identification, preferably in the form of a ridge on the keytop edge nearest to the user.
- Frequently used keys, such as ENTER, SHIFT, ESCAPE, CTRL, BACKSPACE etc., should be placed and have a shape that differ from other keys so that they are easy to find.
- The contrast between the colours of the characters and the background of the keytop should be the best possible.
- The height of the characters of the alphanumeric and numeric keys should not be less than 4 mm.



Requirements

Standardisation

- The height of the characters of the other keys should not be less than 4 mm, if there is available space.
- The text on the keys should be printed in sans-serif characters, which is considered to be more easy to read than other typefaces.
- No text should be printed in red or green colour.
- The user should be allowed to customise the keyboard with respect to features such as repeat rate, key activation delay, delay between acceptance of two consecutive key presses, minimum time for pressing a key before the key repeat begins, and serial instead of multiple simultaneous keystrokes etc.
- If sufficient space is available, shift keys (upper and lower case, ctrl, alt etc.) should be duplicated, one on each side of the keyboard, and be placed symmetrically.
- The keyboard should be designed to provide sufficient space to allow the user to mount a keyguard.
- The system should allow the connection of two keyboards, which could be used simultaneously, for instruction purposes.
- The power needed to press a key should be between 0.3 and 0.6 Newton. Preferably, the required power should be adjustable.



The Use of a Pointer Device



Home



Professional



Mobile Environment

- Some persons with reduced hand functions, such as reduced strength, small movements, or shaky hands etc., may encounter difficulties in handling pointing devices, such as mice, joysticks, track balls, touch pads, touch screens etc.

Requirements

Standardisation



Physical

- The user must be enabled to customise pointing device features such as double-click interval, pointer speed etc.
 - The user should be allowed to execute pointing functions from the keyboard.
 - The operation of a pointing device should not require two simultaneous hand movements.
 - The power needed to operate the pointing device should be between 0.3 and 0.6 Newton. Preferably, the required power should be adjustable.
 - Touchscreens should be operable by use of a fingertip as well as a tool.
- Customisation and adjustment of features of pointing devices are discussed in the ongoing work in ISO TC159 on ISO TS 16071, Accessibility of software.
 - There is a large number of different kinds of pointing devices available on the market. This includes mice of various design, including mice for left-handed people. There is no obvious need for standards for design of pointing devices.



Auditory

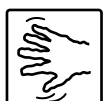
- None identified.



Visual



Cognitive

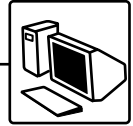


Dexterity

- Same as physical.



Combination



Requirements Related to the Needs of Professionals

Requirements related to the needs of designers and developers



Professional Environment

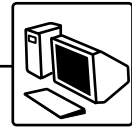
- In Europe there are many small local PC-assemblers who would benefit from having one single easy-to-use guideline to comply with, one that they could identify as agreed by suppliers and consumers, providing minimum requirements and additional recommendations, the latter allowing accessibility to become a domain of competition. Otherwise, since the guidelines are overlapping and sometimes addressing the same specific issue with slightly different wordings, the intended users are faced with the problem of knowing if one guide is better than another in the specific context. Furthermore, a standard guideline would facilitate inclusion of accessibility features in the many new products we will encounter in the near future, the "post-PC era".

Requirements

- There is a need for transforming one design guideline, or compiling the existing guidelines, into a standardisation document, targeted to designers and developers.

Standardisation

- It is clear that there is a sufficient basis of knowledge of user requirements to produce an agreed set of accessibility criteria for personal computers. This knowledge is documented in design guidelines and supplementary informative documents, issued by individual organisations or by co-operation bodies. A broad consensus is likely to be achievable.



Requirements Related to the Needs of Procurers



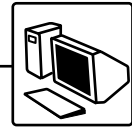
Professional Environment

- The procurement process is different from the design process. Design is increasingly regarded as an iterative process, and the message of the design guidelines is: do as much as you can! Public procurements are strictly regulated, and are definitely not iterative. The procurer is not allowed to add, reformulate or delete requirements and recommendations after the tenders are received. Moreover this is included in the code of good practices for any procurement. If a mandatory requirement is for some reason disregarded in the evaluation of tenders, the suppliers may have submitted their tenders — or refrained from submitting a tender — on false presumptions. Furthermore, since a call-for-tender is based on a decision to purchase, the requirements must be satisfiable by reasonably many products existing in the market. Consequently, the requirements and recommendations to be included in a call-for-tender have to be considered very carefully. Once they are formulated and sent to the suppliers, they must not be changed. This is contrary to the design process, which need to cater for a certain degree of freedom for the designer.
- This implies that a generic guideline intended for designers is not necessarily appropriate for direct use as a requirement specification in a procurement.
- As identified by the SPRITE-S2 project ACCENT, the lack of international and European standards dealing with accessibility of ICT products and services is a limiting factor for the inclusion of accessibility in ICT procurements. Accessibility is ignored partly because there are no widely recognised objective criteria to refer to when procuring products.

Requirements

Standardisation

- | Requirements | Standardisation |
|--|--|
| <ul style="list-style-type: none">- There is a need for a set of mandatory and desirable accessibility requirements to be included or referred to in procurements, especially public procurements. | <ul style="list-style-type: none">- It is clear that there is a sufficient basis of knowledge of user requirements to produce an agreed set of accessibility criteria for personal computers. This knowledge is documented in design guidelines and supplementary informative documents, issued by individual organisations or by co-operation bodies. A broad consensus is likely to be achievable.- The problem is creating a balance. If the requirements are too weak, the standard will be of limited use for the procurers; if the requirements are too strong, the standard will not be accepted by the suppliers. This is however not unique for accessibility. |



Requirements for the Technical Platforms



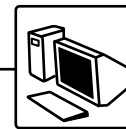
Professional Environment

- By a technical platform is here meant a combination of components such as processor, operating system, network services, programming languages, database management etc., which are standardised or market leading.
- To maximise system accessibility, the platform should comply with the principles of open systems and allow that interoperable, compatible and portable standard application programs, company-specific application programs, and assistive software can be installed and executed. The platform should include as many features as possible which promote accessibility, thus providing the programmer with building blocks with intrinsic accessibility features. A special advantage is that this will facilitate development of assistive software with common user interface and behaviour, which promotes portability and compatibility. Assistive devices could easily be exchanged or upgraded when necessary.

Requirements

Standardisation

- | | |
|---|---|
| <ul style="list-style-type: none">- Enabling flexibility for the user:<ul style="list-style-type: none">- The platform should allow application developers to enable the user to have keyboard access to all commands and options.- The platform should allow application developers to provide the user with the capability to select the output mode of the information according to his/her abilities and preferences.- Interaction with assistive devices:<ul style="list-style-type: none">- The tools and conventions of the platform should support the application developer in producing accessible software.- The platform should enable assistive devices to operate concurrently with all other system functions, yet be transparent to those functions.- The tools and conventions of the platform should support developers of assistive devices. | <ul style="list-style-type: none">- This is not a standardisation issue. Rather, it is a matter of awareness raising and training of developers as regards the needs of disabled and elderly people.- The use of assistive devices in a multi-platform environment is a complex issue. An open, vendor-independent API would be a possible solution. One suggestion would be that CEN/ISSS, as a first step, arranges a one-day workshop or a round table where leading mainstream ICT manufacturers and manufacturers of assistive devices are invited to exchange views, identify problems and explore possible solutions. |
|---|---|



Conclusions

The personal computer, its desktop as well as its notebook version, in the configuration it is sold off-the-shelf, is a well standardised product. This is not the result of formal standardisation, rather a result of proprietary specifications made publicly available and competing in the marketplace. It is not likely that new specifications for the personal computer market segment and gaining market success, will be produced in formal standards bodies.

In general, where the disability community wants to influence the future technical specifications in this market segment, this will need to be made by approaching individual market leading companies or industry consortia such as the group of companies behind the Bluetooth specification.

There are some general principles as regards standards that should be taken into account:

- It is of utmost importance that the future technical specifications in the field of personal computers are open and publicly available. This is necessary for those who need assistive devices. It is necessary that specifications are open and available to manufacturers of assistive devices in order that an individual who needs a specific assistive device should be enabled to use the device with any host computer, thus guaranteeing connectability and interoperability.
- Several guidelines exist on accessibility of computer hardware and software. There is a need for creating one world-wide well recognised standard. This is the purpose of ISO TC159, who currently elaborates ISO TS 16071 on software accessibility, based on a set of previously produced guidelines. The TS is intended for use by interface designers, software developers and purchasers. A similar standard on hardware accessibility would be of great value, especially for purchasers. Since in particular public procurement is a process different from the design process, the recommendations in a procurement guideline

must be strictly formulated, in order that both the supplier and the purchaser can easily verify that the requirements are satisfied. This could be a subsequent issue for ISO TC159 or CEN TC 122.

In addition, there are a few more specific standardisation issues of importance for people with disabilities, which not likely will be addressed by the market forces on their own initiative.

- There is a need for open and modular solutions which ensure that a system for identification and authentication of a user can be introduced or replaced without interfering with the use of assistive devices. The security system and the assistive device or software should be transparent to each other and to the host computer.

- A standard on acceptable levels and measurement methods is required for ensuring that the electromagnetic characteristics of the hardware does not interfere with a hearing aid where the induction pick-up coil is activated. This is an issue for IEC and/or CENELEC.

- Noise emitted from a computer can be more annoying for a hearing impaired person than for other users. A global standard on acceptable levels and measurement methods taking account of the needs of hearing impaired people would substantially facilitate purchaser and consumer choices. This is an issue for IEC and/or CENELEC.

- The use of assistive devices in a multi-platform environment is a complex issue. An open, vendor-independent Application Programming Interface (API) might be a possible solution. One suggestion would be that CEN/ISSS, as a first step, arranges a one-day workshop or a round table where leading mainstream ICT manufacturers and manufacturers of assistive devices are invited to exchange views, identify problems and explore possible solutions.