

प्रगत संगणन विकास केंद्र  
CENTRE FOR DEVELOPMENT OF ADVANCED COMPUTING



इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी मंत्रालय की वैज्ञानिक संस्था, भारत सरकार  
A Scientific Society of the Ministry of Electronics & Information Technology, Government of India

सी-डैक इनोवेशन पार्क,  
स.न. 34/B/1,  
पंचवटी, पाषाण,  
पुणे - 411008, भारत  
C-DAC Innovation Park,  
S. No. 34/B/1,  
Panchavati, Pashan,  
Pune - 411008, India  
फ़ोन / Tel: +91-20-2550 3100  
www.cdac.in

**Lenali Singh**  
Joint Director, Applied AI Group, C-DAC Pune

**Ref. No.:** CDAC/AAIG/Access-Guidelines/20170425/16  
**Date:** 25<sup>th</sup> April 2017


To,  
**Mr. Md Asif Iqbal**  
Senior Manager  
PWC India Pvt. Ltd.  
DN-Sector-5, Salt Lake,  
**Kolkata - 700 091**

**Subject: Preparation of Procurement Specifications/Guidelines for Accessibility**

Dear Sir,

1. This mail is in reference with the MeitY letter No. 18(3)/2016-e-Infra dated 19<sup>th</sup> September, 2016 and 02<sup>nd</sup> March 2017 on the above-mentioned subject (Annexure-I & II).
2. As directed by MeitY, the objective of this exercise is to prepare specifications/guidelines for accessibility for procurement of IT hardware and software to make public procurement accessible. These specifications shall cover the disabilities like: Visual Impairment, Hearing & Speech Impairment, Physical/Mental disabilities or any other disability as relevant.
3. In view of the above, it is requested that the specifications/guidelines as required for the relevant domain of your expertise pertaining to disability be furnished at the earliest for compilation of 'Procurement Specifications/Guidelines for Accessibility', for onward dispatch to MeitY. These specifications should be compatible for inclusion in GeM (Government e-Market) website.
4. Draft document under preparation at C-DAC is also enclosed for reference (Annexure-III).
5. Kindly treat it as '**Urgent**' and send the specifications within 03 days.

Thanks & Regards,

  
**Lenali Singh**

भारत सरकार  
 GOVERNMENT OF INDIA  
 संचार और सूचना प्रौद्योगिकी मंत्रालय  
 MINISTRY OF COMMUNICATIONS AND INFORMATION TECHNOLOGY  
 इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी विभाग  
 DEPARTMENT OF ELECTRONICS AND INFORMATION TECHNOLOGY  
 Website: www.deity.gov.in

संख्या

No.....

18(3)/2016-e-Infra

दिनांक

Date.....

September 19, 2016

**Subject: Specifications for making Public Procurement Accessible – reg.**

Dear Dr. Darbari,

1. This has reference to the meeting of Committee of Secretaries (CoS) held on July 21, 2016 under the chairmanship of Cabinet Secretary to review 'Accessible India Campaign' at Cabinet Secretariat. In the meeting, it was decided that MeitY may prepare accessibility specifications for IT hardware and software to make the public procurement accessible.
2. Since C-DAC, Pune has already accomplished significant projects in various areas of accessibility and developed products such as 'Shruti Drishti', and 'Shrut Lekhan- Rajbhasa'; it is requested that C-DAC, Pune may develop technical specifications of various electronics and ICT items (hardware & software) to make them accessible for differently-abled persons in consultation with all stakeholders.
3. This issues with the approval of JS (SM).

With regards,

Yours' sincerely



(Dipak Singh)

Director & HoD (e-Infra)

Phone: 011- 24364565

To

Dr. Hemant Darbari  
 Executive Director,  
 Centre for Development of Advanced Computing (C-DAC)  
 Pune University Campus, Ganesh Khind  
 Pune - 411 007 Maharashtra

इलेक्ट्रॉनिक्स निकेतन  
 6, सी.जी.ओ. कॉम्प्लेक्स  
 नई दिल्ली-110003

कार्यकारी निदेशक कार्यालय  
 आवक सं./Inword No. : 2973  
 दिनांक/Date : 23.9.16  
 राष्ट्रीय ई-गवर्नेंस योजना  
 National e-Governance Plan  
 Public services closer home

ELECTRONICS NIKETAN  
 6, C.G.O. COMPLEX  
 NEW DELHI-110003

भारत सरकार  
Government of India  
इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी मंत्रालय  
Ministry of Electronics & Information Technology  
इलेक्ट्रॉनिक्स निकेतन, 6, सी जी ओ कॉम्प्लेक्स, नई दिल्ली-110003  
Electronics Niketan, 6, C G O Complex, New Delhi-110003  
Website: www.meity.gov.in

संख्या  
No.....18(3)/2016-E-Infra

दिनांक  
Date.....2-3-2017.....

To

✓ Dr. Hemant Darbari  
Executive Director  
C-DAC,  
Pune University Campus, Ganesh Khind  
Pune – 411007  
Maharashtra.

Subject : Preparation of procurement specification/guidelines for accessibility.

Sir,

I am directed to refer to letter No. CDAC/AAIG/Access-Guidelines/20170224/04 dated 24/02/2017 (copy enclosed) on the above mentioned subject and to inform that C-DAC may prepare specifications of hardware & software by interacting with all the stakeholders through e-mail/phone/video-conferencing etc. and submit the specifications within two weeks time. It is also intimated that for this activity, no funds will be made available by MeitY to C-DAC, Pune.

2. Please send the specifications within two weeks time.

Yours faithfully,

  
( S.K. Tyagi )  
Section Officer  
Ph.: 24301709

कार्यकारी निदेशक कार्यालय/Executive Director Office  
आवेक सं./Inword No. : 22-28  
दिनांक/Date : 6-3-2017



INFORMATION TECHNOLOGY ACCESSIBILITY FOR  
THE PEOPLE WITH DISABILITIES

---



**Policy & Guidelines**

## Foreword

*The Constitution of India ensures equality, freedom, justice and dignity of all individuals and implicitly mandates an inclusive society for all including persons with disabilities. In the recent years, there have been vast and positive changes in the perception of the society towards persons with disabilities. It has been realized that a majority of persons with disabilities can lead a better quality of life if they have equal opportunities and effective access to rehabilitation measures.*

*This document seeks to provide Policy & Guidelines to improve the accessibility of the IT related facilities including World Wide Web (WWW or Web) for the people with disabilities, since they encounter difficulties while not only using computers in general, but also on the Web. Information Technology must be used to design, develop, or create the facilities to be accessible to people with disabilities, including those who use assistive technologies. An effort must be undertaken to ensure the minimum requirements to be complied with pertaining to Information Technology Accessibility; more so, when the Information Technology being a dynamic field is in a constant flux; hence, requirements are also expected to be updated as technology and accessibility-related issues evolve.*

*Persons with disability are an essential part of our society. They can be our friends, neighbours or family members who should have fundamental rights and the freedom to participate on the basis of equality. All the universal systems of the society must be accessible, ensuring policy and legislative commitments are in place for progressive removal of barriers for the disabled persons. It is Society's obligation to ensure that the people with disabilities should not only be provided goods, facilities, premises and services but also the accessibility of a wide range of IT based systems, such as: publicly accessible websites, intranets and other IT systems for their empowerment.*

*All Heads/Administrations should constantly seek to improve the accessibility of their web pages and explore newer and better ways to deliver web content & services as latest technologies and new versions of the Guidelines are developed. Measures should be instituted for awareness-raising, dissemination, education; and especially, training in Web accessibility to integrate everyone, particularly people with disabilities to empower them to be a part of an informed society.*

*Accessibility to the Web is an integral part of public information policy, in such cases, legislation or other policy instruments can ensure effective implementation. Therefore, all efforts must be made to increase efforts to speed up accessibility to the Web and the content it offers.*

## Table of Contents

<b>Foreword</b> .....	<b>5</b>
<b>Policy for IT Accessibility for People with Disabilities</b> .....	<b>7</b>
<b>Compliance / Responsibilities</b> .....	<b>8</b>
A. Implementation of the Policy .....	8
B. Revisions to the Policy .....	8
<b>Policy &amp; Guidelines</b> .....	<b>9</b>
A. Information Technology Accessibility Imperatives .....	9
A. Standards .....	10
B. Exceptions .....	11
<b>ICT Accessibility Interventions for Disabilities</b> .....	<b>12</b>
<b>Specifications for Procurement</b> .....	<b>16</b>
A. IT Resources for Procurement.....	16
B. Assistive Tools/Devices Procurement.....	19
C. Hardware Procurement Specification.....	22
<b>Bibliography</b> .....	<b>25</b>

## **Policy for IT Accessibility for People with Disabilities**

Government of India (GoI) is committed to support an Information Technology (IT) environment that is accessible to all; and in particular to individuals with disabilities. To this end, it seeks to deploy Information Technology that has been designed, developed, or procured to be accessible to people with disabilities, including those who use Assistive Technologies. An accessible IT environment and supporting IT accessibility would ensure, as broad a population as possible, an access, benefit from, and contribute to its electronic programs and services under this policy, for which all organisations and locations must:

- Adhere to the IT Accessibility Requirements, including the establishment of an IT Accessibility Program for all disabled persons.
- Develop, purchase and/or acquire, to the extent feasible, hardware and software products that are accessible to people with disabilities.
- Promote awareness of this policy to all members of the community, particularly those in roles that are responsible for creating, selecting, or maintaining electronic content and applications.

## **Compliance / Responsibilities**

### **A. Implementation of the Policy**

All agencies shall be responsible for facilitating and ensuring implementation of these policies/guidelines at their locations. Heads of the organizations shall be responsible for issuing and updating any requirements, standards or guidelines that support this policy and shall facilitate regular communication to address consistent implementation of this policy. Public procurement policies, as a process used by public agencies to acquire goods, services, works and other supplies should be based on the social justice to empower the disabled-persons while resorting to public procurement. ICT resources should have accessible design, availability and affordability of the products and services, preferably at inception. These should be offered to users at an affordable price.

### **B. Revisions to the Policy**

The Ministry of Electronics & Information Technology has the authority to initiate policy revisions and is responsible for regular reviews and updates as required.



## **Policy & Guidelines**

### **A. Information Technology Accessibility Imperatives**

IT Accessibility Program must establish processes to address IT accessibility in a systematic way at all places, using local structures and practices as appropriate for all types of the disabled persons. It should support interoperability and compatibility between different elements of a system or network or between different products; and also ensure minimum levels of quality, in terms of functionality, safety or durability. The reduction in variety should also be ensured which will allow economies of scale in production.

The respective Heads of the Organisations must designate an individual/nodal point or committee to develop and oversee the Program to promote coordination with systemic IT accessibility initiatives. Any designated individual or committee must represent a broad range of functional areas and be able to address all issues related to disabled people pertaining to day-to-day activities such as: movement, academic, reading-writing or administrative or any other types of concerns and needs. All implementers/stakeholders must be encouraged to be innovative in addressing IT accessibility. At a minimum, the Program must include the following:

- I. Authority and Responsibility:** Assignment of roles, authority, responsibilities and accountability for achieving the policy compliance.
- II. Audience:** A strategy must be devised at all levels to address the different needs of the society, especially with the disabilities to support IT accessibility.
- III. Prioritization:** A process should be put in place to prioritize effort that takes into consideration different needs, practices and available resources, including providing access to centralized IT accessibility support.
- IV. Design Process:** A strategy should be developed to incorporate accessibility into the design and authoring process of electronic information resources considering the needs and local factors.
- V. Procurement:** A procedure should be put in place to incorporate IT accessibility into the procurement process, including establishment of a formal means for evaluating the accessibility of products or systems under consideration for procurement.

- VI. Training:** A training plan should be instituted for personnel who develop and maintain electronic information resources, author web content, or make IT related purchases.
- VII. Awareness Campaign:** A communication map and campaign should be planned to raise awareness about IT accessibility.
- VIII. Compliance Monitoring:** Processes should be introduced for monitoring & reviewing the compliance, including compliance of standards in prevalence or as applicable.
- IX. Evaluation:** An evaluation process should be implemented to measure the effectiveness of the Program.
- X. Exception Process:** A process for determining exceptions and for ensuring the development, documentation, and communication of effective alternate forms of access.

## **A. Standards**

Compliance to standards listed in this section must be considered on high priority in the development & implementation of the IT Accessibility Program and should have an evaluation process for its efficacy.

### **I. Web Standard**

Electronic information should meet the Web Content Accessibility Guidelines (WCAG) 2.0 at level AA Success Criteria in consonance with the World Wide Web Consortium's (W3C) standards for accessibility available at the W3C website.

### **II. ISO Standards: Ergonomics of Human-System Interaction**

Guidance on software accessibility: ISO 9241-171:2008 should be considered which provides ergonomics guidance and specifications for the design of accessible software for use at work, in the home, in education and in public places. It covers issues associated with designing accessible software for people with the widest range of physical, sensory and cognitive abilities, including those who are temporarily disabled, and the elderly. It addresses software considerations for accessibility that complement general design for usability as addressed by ISO 9241-110, ISO 9241-11 to ISO 9241-17, ISO 14915 and ISO 13407.

**B. Exceptions**

Conformance to standards may not always be feasible due to the nature of the content, the purpose of the resource, the lack of accessible solutions, or an unreasonably high administrative or financial cost necessary to make the resource accessible. However, these difficulties do not relieve the concerned implementers of the programs or services from their IT accessibility obligations. They must be prepared to provide content and/or services in a suitable alternative format (e.g., electronic text file or audio description) as appropriate.

## ICT Accessibility Interventions for Disabilities

Various interventions for different types of disabilities, including physical/mental/cognitive, are enumerated below. These representational interventions are to be updated comprehensively from time-to-time and should be at par with any prevalent state-of-the-art technology available.

S.No	Disability	ICT Accessibility Interventions
1	Visual Impairment	<ul style="list-style-type: none"><li>• Books-to-Burn, a text- to-speech file for making books on CD on an Apple computer.</li><li>• JAW (Jobs Access with Speech), most widely used screen reader.</li><li>• Duxbury Braille Translator provides print to Braille and braille to print translations, having different versions for Windows, MS-DOS, and Apple Macintosh</li><li>• The Kurzweil 1000, a system for scanning books and other printed material into a computer and then speaking it aloud through a synthesizer.</li><li>• Braille displays, tactile devices usually placed in front of computer keyboard, to read the contents of computer screen by touch in Braille. Braille embossers produce Braille on special Braille paper. They are connected to computer like a text printer or can be connected to note takers. Basically, work by punching dots onto paper.</li><li>• Text to speech software including screen reader software, optical character recognition software which converts scanned documents to speech, software which reads from the computer clipboard and DAISY player software.</li></ul>
2	Hearing Impairment	<ul style="list-style-type: none"><li>• Flex sensors, they change in resistance depending on the amount of bend on the sensor. They convert</li></ul>

S.No	Disability	ICT Accessibility Interventions
		<p>the change in bend to electrical resistance - the more the bend, the more the resistance value.</p> <ul style="list-style-type: none"> <li>• Handheld Deaf and Dumb Communication Device based on Gesture to Voice and Speech to Image/Word Translation with SMS Sending and Language Teaching Ability. This technology used for data acquisition and transmission</li> <li>• Speech-to-Sign Translation converts speech signals to Sign Language understood by a deaf person</li> <li>• Assistive Listening Devices (ALDs) help amplify the sounds you want to hear, especially where there's a lot of background noise. ALDs can be used with a hearing aid or cochlear implant to help a wearer hear certain sounds better</li> <li>• Augmentative and alternative communication (AAC) devices help people with communication disorders to express themselves, ranging from a simple picture board to a computer program that synthesizes speech from text</li> <li>• Alerting devices connect to a doorbell, telephone, or alarm that emits a loud sound or blinking light to let someone with hearing loss know that an event is taking place.</li> </ul>
3	Loco Motor Impairment, Cerebral Palsy	<ul style="list-style-type: none"> <li>• Special products such as: Orthotic (Calipers) and Prosthetic (Artificial Limbs), appliances, spinal braces, cervical collars, traction kits, rehabilitation aids like wheel chairs, crutches, three-wheelers and special tools and equipment required for fitment of prosthetic and orthotic assemblies by limb fitting centre.</li> </ul>
4	Mental Retardation and	<ul style="list-style-type: none"> <li>• Soothers are objects or devices that a person uses</li> </ul>

S.No	Disability	ICT Accessibility Interventions
	Mental illness	<p>to stay calm. Soothers include electronic devices such as sound machines</p> <ul style="list-style-type: none"> <li>• Digital reminders, including pagers and watches, can help a person stick to a medication schedule. They can also help the person make it to appointments, work, and meetings on time.</li> <li>• Mp3 players and CD players or even ear plugs can block out the noise from other people when a person becomes anxious. These soothers can be helpful in group settings.</li> </ul>
5	Children with learning disabilities	<ul style="list-style-type: none"> <li>• Learning Disability is defined as any device, piece of equipment or system that helps bypass, work around or compensate for an individual's specific learning deficits.</li> <li>• Listening: Certain assistive technology (AT) tools can help people who have difficulty processing and remembering spoken language. Such devices can be used in various settings (e.g., a class lecture, or a meeting with multiple speakers).</li> <li>• Math: Assistive technology (AT) tools for math are designed to help people who struggle with computing, organizing, aligning, and copying math problems down on paper.</li> <li>• Organization and memory: Assistive technology (AT) tools can help a person plan, organize, and keep track of his calendar, schedule, task list, contact information, and miscellaneous notes.</li> <li>• Reading: There is a wide range of assistive technology (AT) tools available to help individuals who struggle with reading. While each type of tool works a little differently, all of these tools help by presenting text as speech. These tools help</li> </ul>

S.No	Disability	ICT Accessibility Interventions
		<p>facilitate decoding, reading fluency, and comprehension.</p> <ul style="list-style-type: none"> <li>• Writing: There is a wide range of assistive technology (AT) tools available to help students who struggle with writing. Some of these tools help students circumvent the actual physical task of writing, while others facilitate proper spelling, punctuation, grammar, word usage, and organization.</li> </ul>
6	Autism	<p>The Open Door Day Programme, Parent Child Training Programme, Educational Intervention Programme, Inclusive Education Facilitation &amp; Support, Social Communication Programme-Bubbles, Inclusive co-curricular activities, Centre based programme for Home management, Extended programme for outstation families, Occupational and Sensory Intervention, Hand writing programme</p>
7	Speech Impairment	<p>VOCAs refer to voice output communication aids. These are electronic devices used by people who are either unable to speak or whose speech is difficult to understand.</p>

## Specifications for Procurement

### A. IT Resources for Procurement

While procuring, IT resources must have features and functionalities to assist persons with all types of disabilities. For example people with visual impairment should have:

<b>Essential Features</b>	<b>Functionality</b>
'Accessibility' options should be implemented including keyboard and mouse features	The system's accessibility services for keyboard or mouse control should be available. System-standard input/output streams and drivers should be utilised. If accessibility controls have been implemented in the software, these should be obvious, robust and easy to use. Audible and visible notification of the status of the accessibility features should be available. Equivalent alternatives for 'sticky keys', key delays and repeat rate control and toggling keys should be provided. Standard system mouse drivers should be implemented, but where alternative mouse drivers have not been enabled, it should be possible to re-assign pointing device button functions. 'Mouse keys' functionality should be available.
Software should be compatible with common assistive technology	User interface information should be available to Assistive Technology (AT). Applications should allow AT to change focus and selection and to have access to common system resources. AT should be able to access information and descriptions and be able to exercise control of the user interface. Some industry-standard development technologies may not support all of these features; developers should use tools that do.
Availability of alternative inputs/output	Enable user input/output choice and switching between alternatives, preferably without having to re-start the system or program.
Provision should be made for alternative mouse pointing devices such as head and eye	Where not provided by the system or AT software, include adjustments for the delay to pointer-button-press acceptance, adjustment of multiple-click parameters, pointer speed, and pointer acceleration. Include accessible alternatives to button-hold functionality (e.g.



Essential Features	Functionality
operated systems	dragging) and for complex pointing device functions such as shift+mouse click and for simultaneous button operations. Utilities that can set the orientation of the mouse should be enabled.
Large mouse pointers should be enabled, and large targets or hotspots provided	All point and click targets should be large enough to give access to persons with disability. Button bars should have a large format option. It should be possible to increase the mouse pointer icon to the maximum allowed by the system. Provide a high visibility cursor at the text insertion point. Enable the system (or provide another way) to aid location of the mouse pointer, particularly in complex visual environments.
Documentation should be provided that is easily understood and available in accessible electronic forms	In addition, training and support should be available for accessibility as well as the product itself.
Access interface controls and labels should be available to assistive technology	It is important that these names are understandable, meaningful and short, to facilitate ease of use with screen-readers.
Menus and controls should be accessible from the keyboard	Standard and long-list menu navigation should be possible from keyboard and pointer control. Provide highlights in the menus that clearly indicate the current focus. Keep all menus as short as feasible. Provide keyboard input and control of all standard software functions using the common operating system conventions. This includes standard keyboard shortcuts to functions, menus and dialogue boxes. Avoid shortcuts that are commonly used by AT.
Application windows should be easily identifiable and simply manipulated	Use meaningful and unique window titles. Do not conflict with 'always-on-top' windows used by AT software. Any windows should be able to be re-sized and re-positioned. No windows should automatically take focus away from AT. Provide a high-visibility option to show current focus of windows and controls (for example, buttons and links).

Essential Features	Functionality
	Use the standard system keyboard shortcuts for changing focus.
Supplementary materials should be provided for multimedia content	Where audio and/or video media are used which is essential to the educational objective, equivalent material should be available in alternative forms. If the original media are updated, the alternatives must be updated at the same time. Give users control of audio volume and make visual alternatives available for any audio output.
Captions and labels should follow system settings as an option, or should have application wide user preferences	Where labels and captions are used, ensure inability of system-wide control of captioning. To the extent possible use system settings for captioning. Position any captions so they do not obscure content, and allow the customization of text sizes, colors and typeface.
Customization of text presentation should be possible, including typeface, font size, colour and background colour to provide high contrast	<p>Choose color schemes with good contrast between foreground and background. Implement the system settings for text or alternatively, provide facilities for the individualisation of colour. Do not use colour alone to convey information unless this is the actual task.</p> <p>On networked applications, it would be helpful if the settings were available from any machine on the system and automatically applied when logging on. The preferences could be attached to the user profile and/or local settings.</p> <p>Users should be able to customise and make simple adjustments of their preference settings, particularly of text sizes and colours of common parts of the user interface. The settings should be stored and easily recovered for individual users. It should also be possible to customise the cursor and pointer.</p>
Easy-to-read alternative texts should be provided	Simplified or shorter language (preferable vernacular) alternatives of texts should be provided for those with reading difficulties or for quick scanning by screen-readers. Avoid over-long Alt texts for images. Take care with the layout of information so that it is in recognisable, short 'chunks'.
Diagrams should be clear and have good	Users should be able to change the visibility of lines and other graphic items on screen. Off-screen information should be avoided. Provide a

Essential Features	Functionality
visibility	zoom tool for small diagrams or allow them to be copied to the clipboard.
Do not use flickering screens	<p>In order to avoid triggering epileptic episodes, do not flash large areas of the screen.</p> <p>Epilepsy Action defines the photosensitivity range: ‘Most people with photosensitive epilepsy are sensitive to flickering around 16–25Hz, although some people may be sensitive to rates as low as 3Hz and as high as 60Hz.’</p>
Allow all text to be copied	<p>Wherever text is used, it should be possible to copy and paste where text entry is enabled and copy it in non-editable text areas. If the software does not offer a built-in spelling checker, users should be able to extract text to use it with alternative applications such as speech output, spell checkers or viewers. Text should not be presented as a pure graphic without alt text being available. Warning or error information should be available as text, in a consistent user interface design. Understandable alternatives to on-screen text such as audible warnings should be provided.</p>

## B. Assistive Tools/Devices Procurement

Assistive technology should be considered while procuring ICT Tools, which will ensure supportive, adaptive, and rehabilitative devices for people with disabilities and should help in selecting, locating, and using them.

Assistive technologies should cover all types of disabilities; such as:

- People with physical disabilities that affect movement, who should have access to mobility aids, such as wheelchairs, scooters, walkers, canes, crutches, prosthetic devices, and orthotic devices, to enhance their mobility.
- Hearing aids can improve hearing ability in persons with hearing problems.
- Cognitive assistance, including computer or electrical assistive devices, can help people function following brain injury/impairment.

- Computer software and hardware, such as voice recognition programs, screen readers/narrators, and screen enlargement applications, which should help people with mobility and sensory impairments to use computer technology. Following should be considered:
- Alternative keyboards: featuring larger- or smaller-than-standard keys or keyboards, alternative key configurations, and keyboards for use with one hand.
- Electronic pointing devices: used to control the cursor on the screen without use of hands. Devices used include ultrasound, infrared beams, eye movements, nerve signals, or brain waves.
- Wands and sticks: worn on the head, held in the mouth or strapped to the chin and used to press keys on the keyboard
- Joysticks: manipulated by hand, feet, chin, etc. and used to control the cursor on screen.
- Trackballs: movable balls on top of a base that can be used to move the cursor on screen.
- Touch screens: allow direct selection or activation of the computer by touching the screen, making it easier to select an option directly rather than through a mouse movement or keyboard. Touch screens are either built into the computer monitor or can be added onto a computer monitor.
- Assistive devices, such as automatic page-turners, book holders, and adapted pencil grips, allow learners with disabilities to participate in educational activities.
- Closed captioning would assist people with hearing impairments to enjoy movies and television programs.
- Barriers in community buildings, businesses, and workplaces should be removed or modified to improve accessibility, e.g., ramps, automatic door openers, grab bars, and wider doorways.
- Lightweight, high-performance wheelchairs should be designed ergonomically for organized sports, such as: basketball, tennis, and racing.
- Adaptive switches should be made to make it possible for a child with limited motor skills to play with toys and games.
- Different types of devices should be developed to help people with disabilities perform such tasks as cooking, dressing, and grooming, e.g., kitchen implements with large, cushioned grips to help people with weakness or arthritis in their hands. Medication dispensers with alarms can help people remember to take their medicine on time.

People who use wheelchairs for mobility can use extendable reaching devices to reach items on shelves.

- Braille Embossers transfer computer generated text into embossed Braille output. Braille translation programs should be issued to convert text scanned-in or generated via standard word processing programs into Braille, which can be printed on the embosser.
- Keyboard Filters, typing aids such as word prediction utilities and add-on spelling checkers that reduce the required number of keystrokes should be used so far as possible so that users can quickly access the letters they need and avoid inadvertently selecting keys they do not want.
- Light Signaler Alerts monitor computer sounds and alert the computer user with light signals. This is useful when a computer user cannot hear computer sounds or is not directly in front of the computer screen. As an example, a light can flash alerting the user when a new e-mail message has arrived or a computer command has completed.
- On-screen Keyboards provide an image of a standard or modified keyboard on the computer screen that allows the user to select keys with a mouse, touch screen, trackball, joystick, switch, or electronic pointing device. On-screen keyboards often have a scanning option that highlights individual keys that can be selected by the user. On-screen keyboards are helpful for individuals who are not able to use a standard keyboard due to dexterity or mobility difficulties.
- Reading Tools and Learning Disabilities Programs include software and hardware designed to make text-based materials more accessible for people who have difficulty with reading. Options can include scanning, reformatting, navigating, or speaking text out loud. These programs are helpful for those who have difficulty seeing or manipulating conventional print materials; people who are developing new literacy skills or who are learning English as a foreign language; and people who comprehend better when they hear and see text highlighted simultaneously.
- Refreshable Braille Displays provide tactile output of information represented on the computer screen. A Braille "cell" is composed of a series of dots. The pattern of the dots and various combinations of the cells are used in place of letters. Refreshable Braille displays mechanically lift small rounded plastic or metal pins as needed to form Braille characters. The user reads the Braille letters with his or her fingers, and then, after a line is read, can refresh the display to read the next line.

- Screen Enlargers, or Screen Magnifiers, work like a magnifying glass for the computer by enlarging a portion of the screen which can increase legibility and make it easier to see items on the computer. Some screen enlargers allow a person to zoom in and out on a particular area of the screen.
- Screen Readers are used to verbalize, or "speak," everything on the screen including text, graphics, control buttons, and menus into a computerized voice that is spoken aloud. In essence, a screen reader transforms a graphic user interface (GUI) into an audio interface. Screen readers are essential for computer users who are blind.
- Speech Recognition or Voice Recognition Programs, allow people to give commands and enter data using their voices rather than a mouse or keyboard. Voice recognition systems use a microphone attached to the computer, which can be used to create text documents such as letters or e-mail messages, browse the Internet, and navigate among applications and menus by voice.
- Text-to-Speech (TTS) or Speech Synthesizers receive information going to the screen in the form of letters, numbers, and punctuation marks, and then "speak" it out loud in a computerized voice. Using speech synthesizers allows computer users who are blind or who have learning difficulties to hear what they are typing and also provide a spoken voice for individuals who cannot communicate orally, but can communicate their thoughts through typing.
- Talking and Large-print Word Processors are software programs that use speech synthesizers to provide auditory feedback of what is typed. Large-print word processors allow the user to view everything in large text without added screen enlargement.
- TTY/TDD Conversion Modems are connected between computers and telephones to allow an individual to type a message on a computer and send it to a TTY/TDD telephone or other Baudot equipped device.

### **C. Hardware Procurement Specification**

Following guidelines should be considered during procurement of hardware to assist persons with disabilities:

- Keys, controls and latches should be easily within reach, identifiable by touch, usable with one hand and easy to manipulate.
  - For many people with disabilities, limited dexterity, strength and movement make it difficult or impossible to reach or activate poorly designed hardware features.
  - Activate each control, key or latch to verify that it is easily operated or activated

- Keys and controls should be identifiable by touch without activating them.
  - Hardware should be usable by all persons, and industry standardization in controls makes identification by touch readily available for most types of equipment. If this feature is not available then equipment should be labeled with appropriate touch identifiable labels.
  - Verify that all necessary controls are easily identifiable by touch alone.
  
- If keystroke repeat is supported, the delay between repeat should be adjustable to up to two seconds per keystroke.
  - For individuals with limited fine motor dexterity or control, key activation needs to be adjustable to avoid repeated key strokes or improper keystrokes from being entered.
  - Adjust the keystroke timing within with the operating system to insure that appropriate timing intervals are available.
  
- The key or control status should be identifiable by touch, sight or sounds.
  - Key or control status should be identifiable in other ways than by visual verification.
  - Test for the appropriate functionality of audio, tactile and visual status indicators.
  
- If touch-screen or touch operated controls are used, they should comply with following guidelines and allow for the use of alternative input devices.
  - Individuals with a variety of mobility related disabilities should be able to fully operate all hardware systems.
  - Verify that hardware controls can be activated effectively or with an alternative input device
  
- Alternative forms of user identification should be provided on systems that use biometrics.
  - Many forms of biometrics require that users touch or view into the verification device; many individuals with disabilities do not have the capability to operate these types of verification systems.

- Verify that the user can activate the system without the need to use the biometrics.
- Industry standard ports should be provided for alternative input and output devices
  - To meet the needs of persons with disabilities, the ability to attach a variety of adaptive hardware products is necessary. Adaptive hardware often requires that standard serial and parallel ports be available.
  - Verify that the appropriate ports are present and active on the hardware.



## Bibliography

1. <http://mandate376.standards.eu/procurement-stages/call-for-tender/technical-specification>
2. <http://www.brodies.com/node/833>
3. <http://www.georgefox.edu/offices/it/policies/procurement-policy.html>
4. <http://www.dinf.ne.jp/doc/english/intl/z15/z15002p2/z1500205.html>
5. <http://hearing.wustl.edu/Hearing-Aids/Features-of-Hearing-Aid-Technology>
6. <http://www.dinf.ne.jp/doc/english/intl/z15/z15002p2/z1500205.html>
7. [https://en.wikipedia.org/wiki/Assistive\\_technology](https://en.wikipedia.org/wiki/Assistive_technology)
8. <http://oregonstate.edu/accessibility/hardware>
9. <https://www.iso.org/standard/39080.html>

## **Glossary**

**Accessibility:** Refers to the concept that people with disabilities are able to access and use a product or system, including with the help of assistive technologies. Alternatively, it can be considered as a wide concept that includes the prevention and elimination of obstacles that pose problems for persons with disabilities in using products, services and infrastructures. For example, an “accessible” Web site may be designed so that the text can be enlarged by the user, rather than having a fixed font size, or may be designed so that it can be interpreted and “read out loud” by screen reader software used by blind or low-vision people. It is a measure of whether or not users with different needs or people with a range of disabilities can gain access to information or have control of a system.

An example would be a web page where all the links can be tabbed to with the keyboard, but which has 100 links on the screen, so that the user has to press the tab key many times, read many links with a screen reader, or make perhaps over 100 switch presses to reach the desired link. Whilst accessibility is paramount, developers should also bear usability in mind in designing software resources. Accessibility is a priority issue in policy formation to promote equalization of opportunities for persons with disabilities. Persons with disability should be considered as beneficiaries for sustainability, equity and inclusive development, which have been identified as priorities in policy options.

**Accessible Information Technology:** Information technology that has been designed, developed, or procured to be usable by, and therefore accessible to people with disabilities, including those who use assistive technologies.

**Assistive Technologies:** Adaptive, rehabilitative devices that promote greater independence for individuals with disabilities by changing how these individuals interact with technology. Examples include special input devices (e.g., head or foot mouse, puff-and-sip switches, speech recognition), screen-reading software, and screen magnifiers.

**Usability:** Refers to how easily, effectively, and efficiently users can use a product or system to achieve their goals, and how satisfied they are with the experience. In other words, it is a measure of whether or not users with different needs or people with a range of disabilities can use information or have efficient control of a system in the most practical way.