

Literature Review
Procurement Standard for Accessible Mobile Devices
Vision Loss Users

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1 Introduction

People are different. We are short, tall, young, old, quick, and slow. Our abilities to see, hear, react, and move vary between people and with age. By not taking this into consideration, businesses can inadvertently make it difficult for 15% of their potential customers to use their products and services, specifically older adults and people with disabilities. This number is only growing as consumers collectively grow older, but many products and services remain inaccessible to them. An accessible product or service is one which can be used by all its intended users, considering their differing capabilities and abilities.

This document puts forward a framework to allow procurement staff, designers, and suppliers of mobile devices to understand the needs of people with visual disabilities. It also provides a framework for existing best practices regarding the design of solutions that would accommodate the needs of those people with disabilities. Though the abilities of people with disabilities, whether they have a visual disability or one of the other 3 main disability categories (sight, mobility, and cognitive) exist along a continuous spectrum, most solutions can be categorized into three main categories (mild, moderate, and severe). There is an overlap in the range of abilities to interact with specific technologies within each of these broader categories.

This document uses three main categories (mild, moderate, and severe) to simplify the task for the designers, manufacturers, and procurement staff. It is possible to use other categorizations, but the authors of this paper have tried to balance the need for usability and choice for the end users with the overall complexity that would be put on the users of this document if more categories are used.

2 Definitions

- ***Accessibility*** – the “extent to which a consumer or user can obtain a good or service at the time it is needed”. Accessibility, as it applies to people with disabilities, recognizes that individuals have differing levels of physical and mental capabilities. Additionally, it recognizes the need to deliver goods or services in an efficient and timely manner

that can be easily consumed or used by these individuals. These products and services must consider those differences.

- **Disability** – any restriction or lack (resulting from an impairment) of the ability to perform an activity in the manner or within the range considered normal for a human being.
- **Handicap** – a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfilment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual.
- **Impairment** – a loss or abnormality of psychological, physiological, or anatomical structure or function.
- **Appropriateness** – a measure of how well the assistive technology solution maximizes the user's ability to help them complete the user's intended task in the most efficient manner.

The appropriateness of a solution measures whether the solutions use is obvious, predictable, and consistent, whether the design matches the anthropometric and biomechanical capabilities (essentially the abilities) of users while providing sufficient feedback, controllability, and responsiveness to meet the users' expectations regarding the efficiency of completing the task.

Appropriateness of a solution can be measured by the following dimensions:

- **Operability** – the intended use of the solution should be obvious, predictable, and consistent.
- **Obvious** – solution is easily seen, perceived, recognized, or understood.
- **Predictability** – solution should match user expectations.
- **Consistency** – solution should behave in the same manner when used in similar situations.
- **User compatibility** – the design should match the anthropometric and biomechanical capabilities (essentially abilities) of users.

- **Feedback** – the device should let the user know when it is responding to the user's actions.
- **Controllability** – the device should be responsive to user's actions.
- **Responsiveness** – quick to react appropriately.
- **Biomechanical load** – the force that must be applied to do a task, the duration of the force applied, and the frequency of which the task is performed.
- **Parallax** – the apparent displacement of an observed object or point of interest due to a change in the position of the observer.
- **Suitability for the widest range of use** – involves designing with the objective of producing solutions that will be useful, acceptable, and available to the widest range of users within the user population. This takes into account their abilities, variations in their capabilities, the diversity of their tasks, and their differing environmental, economic, and social circumstances.
- **Equitable use** – ensures that solutions designed to increase accessibility provide the same means of use for all users that are identical whenever possible; equivalent when not. These solutions must not result in loss of privacy, increased risks to personal safety or security, or the stigmatization of individuals.
- **Robustness** – involves supporting a wide range of options, both in terms of the features provided by ICT equipment or services and in terms of the ability to connect additional ICT equipment, software, and/or services.
- **User Interface Layer** – the user interface layer of the operating system deals with the aspects of the way the user perceives and interacts with the device.
- **Element** – a logical representation of a user interface component. Elements can be passive in that the user cannot interact with them, but some useful information is conveyed to the user. Elements can also be interactive so that a user may interact with

them. A series of elements are typically combined to create an instance of the user interface. An element could be a single pixel or series of pixels that can make up a logical visual grouping, such as a single point, a button, an icon, an edit field, list box, etc. An element can also be a physical representation of the potential user interactions available, such as an icon.

- ***Point of Interest/Points of Interest (POI)*** – a Point of Interest or a set of Points of Interest is an element or set of elements that make up a logical grouping of elements. A POI can be manipulated or rendered a target for potential interaction. A POI narrows the scope of potential interactions and perception of the user interface.
- ***Action*** – an action is performed on an element or series of elements. An action may change the status of a single or multiple properties of an element. An action asks an element to perform an interaction.
- ***Shortcuts*** – achieve the same result as an action or series of actions without it requiring that it interact directly with any elements or series of elements.
- ***Properties*** – describe individual parameters that describe an element, such as position (x, y) if it exists, width and height if it exists, and status. The properties of an element depend on the nature of the element. For example, an element may have no visual representation, and therefore, have no height and width data.
- ***State*** – defines the status of a property which has multiple states (i.e., On/Off).
- ***Events*** – changing the status of a property of an element can generate an event that tells operating system of the device that a property (or properties) has changed its state.
- ***Narrow the range of a point of interest*** – an action can narrow the range of a point of interest (i.e., change the number entries in a list box that are highlighted).
- ***Mobile device*** - a device which is typically characterized by small, portable form-factor having communications functionality as its

primary purpose, and are able to be used while in transit (mobility). The device focuses on handling information-based data (including audio, visual, and text-based forms of information) and related tasks. The device allows the user to perceive the information and interact with it. Typical devices could be feature phones, smartphones, PDAs, and tablets.

2.1 Definition of Accessibility

Accessibility is the “extent to which a consumer or user can obtain a good or service at the time it is needed”. Accessibility as it applies to people with disability recognizes that individuals have differing levels of physical and mental capabilities and skills. To deliver goods or services in an efficient and timely manner, those products and services must take into account those differences. In practical terms it means all users can perceive, understand, navigate, and interact with the technology.

From the perspective of a product designer or a procurement staff member without an extensive knowledge of the issues faced by people with disabilities this can appear to be a daunting task, but it does not have to be. People with disabilities fall into 5 main categories:

- Mobility
- Vision
- Hearing
- Cognitive
- Speech

Within each of these 4 disability groups are people with varying levels of severity, ranging from very mild to very severe. By reviewing the abilities across the range of users, a few types of solutions emerge. These solutions will meet the needs of users with typically only minor adjustments necessary to customize the solution to their needs. People can also have multiple forms of disabilities. Adjusting to make allowance for the requirement of each of the dimensions of an individual's abilities will heavily affect the final choice of best practice the mobile device needs to support. Ensuring that the end user has their preferences reflected in the choice of

mobile device and supporting assistive technology is important in ensuring the technology is not abandoned.¹²

A particular piece of assistive technology (AT) may suffer from a lack of adherence or abandonment if it does not physically fit a user's body or causes long-term discomfort. A few categories of such AT may be something to wear (such as a hearing aid), to sit in (like a power wheelchair), or to hold (say, a joystick). There is also a chance of abandonment if the AT does not permit the completion of some or all the tasks that the user desires but cannot execute without an AT with ease. Research indicates that one of the predictors of abandonment is a change in the needs of users, be it permanent (such as progressively worsening sight conditions), temporary (like, for example, increased Parkinson's tremors that can be alleviated through medication), or fluctuating (such as stress-induced spelling difficulties for people with dyslexia) changes. Technology that is simpler to modify to the changing needs of the user or their circumstance may be able to accommodate such changes. Another predictor that leads to abandonment is trouble with configuring and changing AT settings. The issues associated with abandoning are made worse by the fact that an AT is frequently required rather than desired. AT frequently revolves around performing a task or not; it is not about performing a task more quickly and effectively.³

This document breaks down issues into easy-to understand concepts, gives a basic understanding of the types of disabilities and the characteristics that define the abilities associated with people with disabilities, and provides guidance on how to identify and design for the needs of these consumers into the design or procurement processes.

2.2 Definition of Impairment

The World Health Organization (WHO) suggested the following definition in 1980 for the term 'impairment':

“Impairment, a restriction of one's capabilities and disabilities, the lack of the ability to perform tasks due to an impairment or impairments, may be temporary or permanent, reversible or

¹ Hongxin Zhao. “Predictors of Assistive Technology Abandonment“. 1993, Assistive Technology.
https://www.academia.edu/37423321/Predictors_of_Assistive_Technology_Abandonment

² Stefan Carmien. “Assistive Technology Abandonment: Research Realities and Potentials”. Lecture Notes in Computer Science.

³ Stefan Carmien. “Assistive Technology Abandonment: Research Realities and Potentials”. Lecture Notes in Computer Science.
https://www.academia.edu/61339073/Assistive_Technology_Abandonment_Research_Realities_and_Potentials.

irreversible, and progressive or regressive. The situation people find themselves in may determine to what degree a disability is handicapping for them. A handicap can be the result of both an impairment and of environmental conditions. If environmental barriers are taken away, the person will still be impaired, but not necessarily handicapped.”

2.3 Categorization of Major Disability Groups

People with disabilities can have varying levels of severity, ranging from very mild to very severe. They can also have multiple forms of disabilities. To simplify the process of categorizing features that can support specific disabilities, we can categorize the disability community into 5 distinct groups:

1. Vision
2. Mobility
3. Hearing
4. Cognitive
5. Speech

To simplify the number of approaches for dealing with the requirements of people with disabilities, with respect to technology, each one of these disability categories can be further broken down into 3 broader sub-categories of users, based on the level of severity of their disability— mild, moderate, and severe. While the capabilities and skills of any specific individual who has a disability are unique to them, typically the number of feasible and practical technology-based solutions can be classified into these three broader categories of users.

3 High Level Principles for Accessibility

Accessibility is about making a product or service accessible to the widest audience of users. Regardless of the nature of the disability in practical terms it relies on 5 basic concepts:

- Can all users reach the product or service without hindrance?
- Can all users perceive the controls, instructions, output, and labelling of the system?

- Can all users understand what to do and what is being conveyed?
- Can all users navigate the content and controls of the system?
- Can all users interact with the content and the controls of the technology?

A product or service will be accessible to the widest possible audience if the above conditions are met.

4 Practical Accessibility – “Best Practices”

A “best practice” as defined in the document is an accessibility solution that lets the user complete all the primary tasks he wants to complete. A primary task is an activity that is associated with the fundamental functions of that device. For a mobile device this might be placing a phone call or sending and receiving a text message or email. Being able to play a game or shop for a product on the device while possible is not a primary task associated with a mobile device, which is a communication tool. This narrow definition is being used in the procurement process. A best practice may be a new solution that is relevant to helping a user with a specific set of abilities complete their list of primary tasks or an established solution that currently exists in mobile devices. Established solutions will typically have an established set of features that most users with those specific abilities expect. Note that a class of solutions define solutions that have similar core functionalities, but each solution may have additional features that are unique to that implementation.

5 The Roles of Tasks in Selecting Relevant Solutions

To characterize and sort relevant tasks, five accessibility operational tasks (perceive, recognize, monitor, reach, operate) can be used (**Table 1**). For people with visual disabilities, the most frequent task barriers when using their mobile devices are difficulties with the informative tasks, i.e., ‘perceiving’, ‘recognizing’, and ‘monitoring’ visual events or changes to the mobile device. The most common issues creating these barriers are insufficient audio feedback and lack of linear organization of audio interfaces.

Table 1. Definition of accessibility operational tasks.⁴

Accessibility Operational Tasks	Definition (IEC 63008)
Perceive	To find the product and its parts required to perform the task
Recognize	To identify/understand the parts required to perform the task
Monitor	To receive feedback on the operation
Reach	Physical access to the parts required to perform the task
Operate	To perform the task

5.1 Specific Tasks the User Wants to Accomplish

The focus of this document is to define the accessibility of mobile devices with a focus on the primary function of a mobile device: communication. Communications include the concept of ‘advanced communications.’

‘Advanced Communications Services’ is a descriptor for newer, internet-based communication systems that were not regulated by existing communications laws. There are four types of Advanced Communications Services covered by the CVAA:

- **Interconnected Voice over Internet Protocol (VoIP) services** allow users to make and receive traditional phone calls. Examples include RingCentral, Vonage and MagicJack, as well as some phone services offered through cable and internet providers.
- **Non-interconnected VoIP services** provide voice-control without traditional telephone systems. Examples include Siri, Alexa, and other voice chat services.

⁴ Lee, J., Kim, Y., Rhiu, I., & Yun, M. (2021). A Persona-Based Approach for Identifying Accessibility Issues in Elderly and Disabled Users’ Interaction with Home Appliances. *Applied Sciences*, 11, 368. <https://doi.org/10.3390/app11010368>

- **Electronic messaging services** offer real-time or near real-time text-based messaging, including text messaging, instant messaging, text-based chat, and email. Examples include Facebook Messenger, IOS voice-to-text, Slack, and Google's Gmail.
- **Inter-operable video conferencing services** provide real-time video communications. Examples include Zoom, Join.me, Google Hangouts, FaceTime, and other video conferencing/video chat services".^{5,6}

The definition above is derived from the American 21st Century Communication and Video Accessibility Act (CVAA). More detail can be seen in Appendix A (which summarizes key points of the Act). Prior to the Act, mobile devices were only defined as voice communicators, and any accessibility requirements thus only pertained to tasks involving voice calling. The CVAA is the first legislative attempt at defining "advanced communications" that go beyond voice calling. The new definition recognizes that mobile phones and their usage patterns have changed over time. The FCC used to be the regulatory power that oversaw the application of accessibility requirements. Therefore, the scope of accessibility requirements applied to communication and broadcast services only more specifically to mobile devices (hardware and software) as it applied to the implementation of advanced communication interactions.

The best practices on how to achieve accessibility are best described for specific use cases. The individual steps that need to be used to complete a task can be generalized to other methods of interaction and other use cases though. They are usually independent of the app being used. For example, making a phone call requires that the user complete the following specific steps or interactions:

1. *Locate and identify the phone (by shape or texture)*
 - a. Individuals with mild and moderate vision related issues should be able to locate and retrieve the device without difficulty, typically by shape and weight. Those with severe vision related issues need to have their device put away in a consistent location to be easily located.
2. *Orientate themselves on the phone so that they can perceive the display and controls (what is the top of the phone)*

⁵ Advanced Communications Services and the CVAA (levelaccess.com)

⁶ Advanced Communications Services (ACS)", Federal Communication Commission of the United States. Retrieved from: <https://www.fcc.gov/general/advanced-communications-services-ac>s

- a. This should not be an issue for any of the individuals within each of the severity levels. It is important to note that most current phones typically have buttons either on the front face of the device or the side of the device that typically help to denote the top or bottom of the device. It is important to maintain those distinctions for individuals who have severe levels of issues that affect their vision.
- 3. *Turn on the device or unlock it (locate and interact with power button, interact with biometric and/or password system)*
 - a. After an initial orientation period, it should not be any more difficult to accomplish this task than it is for a person without any disabilities.
- 4. *Perceive the output and controls of the device*
 - a. How output from the device is perceived varies depending on the level of severity of the condition that affects the individual user's vision.
 - i. Mild vision loss
 - 1. With sufficient size and contrast text and visual elements like icons and controls can be perceived by this group of users
 - ii. Moderate vision loss
 - 1. With sufficient size and contrast text and visual elements like icons and controls can be perceived by this group of users. The size of text and elements usually exceeds the ability to display a substantial number of elements on the screen at the same time and text may exceed the maximum default font size of text on the device.
 - iii. Severe vision loss
 - 1. This group of users can not perceive the normal graphic display on mobile devices. The context typical is perceived by converting the text and visual elements into audio equivalents or tactile equivalents.
- 5. *Interact with the device applications and controls*
- 6. *Launching the Phone app*
- 7. *Enter a phone number*
- 8. *Acknowledge a proper connection*

9. *Communicate with the person being called and responding to the person*
10. *Terminate the call when finished.*

Embedded in these steps are the needs to select a point of interest, set the focus to a point of interest, activate that point of interest, enter data into the point of interest or perceive output for that point of interest and enter data into an appropriate point of interest. Different combinations of these interactions are embedded in commonly performed tasks on a mobile device.

Rather than test for each of these individual interactions for their degree of accessibility compliance for the different personas presented in this document, a series of tests around end-user goals was created. The nature of the interaction may change over time, but the end-user goals will change slowly. For example, voice assistants can now do some tasks or parts of tasks more efficiently than touch-centric interactions for those users that can perform touch interactions.

5.2 Usage Patterns across Mobile Devices

The list of tasks is derived from several research studies looking at the usage patterns of end users. The existing works could be generally categorized into either standard ethnographic and user studies, based on questionnaires, diaries and self-report, or studies based on automatic recording and subsequent analysis of phone activity logs.⁷ In the first category, Reid and Reid (2004) study the differences of call and SMS usage preference using an online questionnaire which involved 982 users.⁸ Grinter and Eldridge (2001) investigate how British teenagers incorporate text messaging into their daily lives.⁹ They collected data by asking the teenagers involved in a study to manually log their texting activity for seven consecutive days. In a more recent example, Barkhuus and Polichar (2011) investigate how users integrate multifunctional mobile phones into their everyday lives.¹⁰ The study was

⁷ Do, T. M. T., Blom, J. and Gatica-Perez, D. (2011) Smartphone usage in the wild: a large scale analysis of applications and context. in Proceedings of the 13th international conference on multimodal interfaces: ACM. pp. 353-360.

⁸ Reid, D. and Reid, F. (2004) Insights into the social and psychological effects of SMS text messaging

⁹ Grinter, R. E. and Eldridge, M. A. (2001) y do tngrs luv 2 txt msg? in ECSCW 2001: Springer. pp. 219-238

¹⁰ Barkhuus, L. and Polichar, V. E. (2011) Empowerment through seamfulness: smart phones in everyday life. Personal and Ubiquitous Computing, 15(6), pp. 629-639

based on interviews and daily diaries and involved 21 users over 3 weeks. The study by Mutchler, Shim, & Ormond (2011) shows another recent work based on data collection from interviews to explore the factors that motivate college students in the U.S. to use smartphones.¹¹ However, the study results discussed above have their limitations. Also, no justifiable conclusion can be derived from their results as the studies were conducted on a small number of subjects. Thus, the ability to collect and record mobile phone usage automatically on a large scale is needed where longitudinal analyses of phone application logs are collected by combining automatic collection of smartphone data and human-centric data analysis.¹² According to the results of studies carried by Parslow, Hepworth, & McKinney (2003), over 93 volunteers were asked to report on the number of their call activities during different periods of time (day, week, or month) and their responses were then compared to log data collected from the mobile phone operators.

There was only a moderate correlation between log data and self-report, indicating that self-report measures do not fully represent actual usage patterns.¹³ Verkasalo and Hammainen (2007) use data collected by Symbian-based monitoring to present a study of voice calls, SMS, email, and Bluetooth messages usage based on a population of 562 subscribers, during seven months.¹⁴ Another study by Wehmeier (2012) was done on a larger scale, based on the data collected from 180,000 smartphone users on the Android platform during a period of one month, to analyze the user behavior trends across cellular networks in domestic and roaming scenarios and through Wi-Fi-based access.¹⁵ Shye et al. (2010) present a comprehensive analysis of real smartphone usage involving 25 subscribers during a 6-month study of real user activity on the android smartphone. The study covers general usage behavior, power consumption interaction with the battery and network

¹¹ Mutchler, L. A., Shim, J. and Ormond, D. (2011) Exploratory Study on Users' Behavior: Smartphone Usage. in AMCIS.

¹² Do, T. M. T., Blom, J. and Gatica-Perez, D. (2011) Smartphone usage in the wild: a largescale analysis of applications and context. in Proceedings of the 13th international conference on multimodal interfaces: ACM. pp. 353-36

¹³ Parslow, R., Hepworth, S. and McKinney, P. (2003) Recall of past use of mobile phone handsets. Radiation protection dosimetry, 106(3), pp. 233-240

¹⁴ Verkasalo, H. and Hämmäinen, H. (2007) A handset-based platform for measuring mobile service usage. info, 9(1), pp. 80-96.

¹⁵ Wehmeier, T. (2012) Understanding today's smartphone user: Demystifying data usage trends on cellular & Wi-Fi networks: Informa Telecoms and Media

activity.¹⁶ Another study by Rahmati and Zhong (2013) uses logging software that runs in the background to perform a four-month field study of usage of 14 smartphones and reports what applications were used, and how the phones were used.¹⁷ Erman et al. (2011) present summaries of their analysis based on anonymized data set from a tier-1 cellular network provider in the U.S. over a week of how, where, and when smartphone apps are used from spatial, temporal, and user perspectives and attempt to understand the impact of location, time, user, and app interest accordingly.¹⁸

Other existing studies, like those done by Falaki et al. (2010)¹⁹ and Xavier et al. (2012)²⁰, have addressed specific aspects of mobile phone design, such as mobility, to enhance user experience under mobility, phone application such as statistics of popular apps and the impact of user activities on the network. However, studies that have been carried out are still unable to gain an adequate understanding of the behavior of smartphone usage. Furthermore, most of the previous studies focused on the usage of specific countries and with limited time and number of users, so the overall picture of smartphone usage is still inadequate. To the best of our knowledge, the authors believe this work will help fill major gaps in forming a better picture of the smartphone usage evolution”.²¹

A study²² of 255 users conducted by Falaki, Mahajan & Kandula in 2010 identified the following usage patterns ranked by frequency of usage on Android and Windows devices (outlined in **Tables 2, 3, 4, 5**):

¹⁶ Shye, A., Scholbrock, B., Memik, G. and Dinda, P. A. (2010) Characterizing and modeling user activity on smartphones: summary. in ACM SIGMETRICS Performance Evaluation Review: ACM. pp. 375-376

¹⁷ Rahmati, A. and Zhong, L. (2013) Studying smartphone usage: lessons from a four-month field study. Mobile Computing, IEEE Transactions on, 12(7), pp. 1417-1427.

¹⁸ Xu, Q., Erman, J., Gerber, A., Mao, Z., Pang, J. and Venkataraman, S. (2011) Identifying diverse usage behaviors of smartphone apps. in Proceedings of the 2011 ACM SIGCOMM conference on Internet measurement conference: ACM. pp. 329-344.

¹⁹ Falaki, H., Mahajan, R., Kandula, S., Lymberopoulos, D., Govindan, R. and Estrin, D. (2010) Diversity in smartphone usage. in Proceedings of the 8th international conference on Mobile systems, applications, and services: ACM. pp. 179-194.

²⁰ Xavier, F. H. Z., Silveira, L. M., Almeida, J. M. d., Ziviani, A., Malab, C. H. S. and Marques-Neto, H. T. (2012) Analyzing the workload dynamics of a mobile phone network in large scale events. in Proceedings of the first workshop on Urban networking: ACM. pp. 37-42

²¹ Amhmed A. Bhih, Princy Johnson, Martin Randles. (2016) Diversity in Smartphone Usage International Conference on Computer Systems and Technologies - CompSysTech'16

²² Hossein Falaki, Ratul Mahajan, Srikanth Kandula. "Diversity in Smartphone Usage". June 2010. DOI: . 10.1145/1814433.1814453. SourceDBLP. Conference: Proceedings of the 8th International Conference

Table 2. Relative rankings—frequency of usage of Tasks for Android Devices.

Rank	Active Process
1	Alarm Clock
2	Talk
3	Contacts
4	Maps
5	MMS
6	Phone
7	Music
8	Browser
9	Camera
10	Vending
11	Calendar
12	Settings
13	Games - Tetris

Table 3. Relative rankings - frequency of usage of Tasks for Windows Mobile Devices.

Rank	Active Process
1	Explorer
2	Gmail
3	Bubble breaker
4	Poker
5	Live Search
6	Calendar
7	Google Maps

Table 4. Breakdown of percentage usage of process for Android Devices.

Rank	Process	Relative Percent of Usage
1	Communications	44%
2	Productivity	19%
3	Other	11%
4	Browsing	10%
5	Media	5%
6	Maps	5%
7	System	5%
8	Games	2%

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Table 5. Breakdown of percentage usage of process for Windows Mobile Devices

Rank	Process	Relative Percent of Usage
1	Communications	49%
2	Other	15%
3	Browsing	12%
4	Games	10%
5	Media	9%
6	Maps	2%
7	Productivity	2%
8	System	1%

We organize applications into eight unique categories to provide an aggregate view of what consumers do with their cellphones:

- a) Communication includes apps for sending and receiving messages (e.g., email, SMS, IM) as well as making voice calls.
- b) Browsing the Web, such as through a browser, search engines, and social networking applications;
- c) Media consumption and creation (e.g., pictures, music, videos);
- d) Calendars, alarms, and software for opening or creating files (e.g., Office, PDF Reader)
- e) Changing user preferences or viewing user state (e.g., file explorer)
- f) Games
- g) Map and GPS systems
- h) Any other applications that could not be sorted into aforementioned categories, e.g., because of unknown functionality.

Communication dominates is the most utilized category. Browsing is another extensively used category. Maps, media, and games have a relatively lesser but still substantial portion of user attention.²³

We note there are limitations to the 2010 study. More recent data from Inside Intelligence suggest that the vast majority of mobile time is spent while connected to the Internet, with 88% of that time within apps.²⁴

Distinguishing between the time spent in an app and a browser is still not straightforward. A study published in 2019 by Kargo and Verto Analytics claims that at least 9% of the time users spend on Facebook actually occurs in embedded browsers, outside of their designated application. In addition, advanced websites are largely comparable to apps in terms of experience.²⁵

As a result, access to the browser in an accessible way takes on greater significance. Data on App downloads from the Apple App store can also provide additional insight. A link of the most popular App can be found at this link: <https://www.statista.com/statistics/270291/popular-categories-in-the-app-store/>

From this list the tasks that are related directly or indirectly to business and productivity related tasks have been identified and extracted from this list. Tasks such as social media may only apply to a small number of employees tasked with maintaining government accounts and monitoring relevant government-related third-party accounts. Similarly, photos and video are relevant as they apply to the ability to record and document professional development sessions and related government or work-related events. Similarly, the ability to play music is related to being able to play audio files from a work-related event or activity. There are some duo purpose tasks that

²³ Hossein Falaki, Ratul Mahajan, Srikanth Kandula. "Diversity in Smartphone Usage". June 2010. DOI: . 10.1145/1814433.1814453. SourceDBLP. Conference: Proceedings of the 8th International Conference on Mobile Systems, Applications, and Services (MobiSys 2010), San Francisco, California, USA, June 15-18, 2010.

²⁴ Yoram Wurmser. "The Majority of Americans' Mobile Time Spent Takes Place in Apps". Insider Intelligence. Jul 9, 2020. <https://www.emarketer.com/content/the-majority-of-americans-mobile-time-spent-takes-place-in-apps>

²⁵ Yoram Wurmser. "The Majority of Americans' Mobile Time Spent Takes Place in Apps". Insider Intelligence. Jul 9, 2020. <https://www.emarketer.com/content/the-majority-of-americans-mobile>

do not seem business related at first glance but do have applications outside of their category that are directly or indirectly related to work activities.

From that list, the following apps categories have been identified as work-related:

Table 6. Work-related application categories.

App Category	Percent of downloads
Business	10.7%
Education	8.66%
Utilities	6.39%
Productivity	3.21%
Social Networking	2.33%
Book	2.24%
Music	2.24%
Photo and Video	1.97%
Reference	1.89%
News	1.78%

5.3 Primary Task List for Mobile Devices

The list below lists the primary tasks that people of all abilities should have access to, including people with vision impairment. The list is derived from the tasks identified in the studies above.

Table 7. Primary tasks that people of all abilities should have access to.

#	Task
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1	Reading the instructions on how to use the device that comes with the device packaging or is available from an online source
2	Setting up the device for the first time
3	Making and terminating a communications session (phone calls, videos call or text message session)
4	Receiving communication session (phone calls, videos call or text message session)
5	Sending text messages to a person in their contact list and to a specific phone number
6	Receiving text messages
7	Send and Receiving email using an app
8	Using a web browser to navigate to a URL, scroll to the end of the URL, interact with the controls on the webpage, enter text in the edit controls on that webpage and the browser controls (reload, forward and back, menu for browser).
9	Using a calendar including entering a new appointment for a date one month in the future and looking up an appointment already scheduled for this week.
10	Taking pictures/video and save it to the mobile device
11	Watching videos or listening to music including changing volume
12	Complete a video call or meeting (FaceTime, no equivalent in Android that is shipped with phone - Duo).
13	Receive low battery notification
14	Change setting on the mobile device such as display brightness, default font size
15	Turn on the power to the phone
16	Turn off the power to the phone

17	Turn volume up
18	Turn volume down
19	Charge the mobile device

Note: There are many services and applications that can run on mobile devices that can help individuals with vision-related issues deal with tasks they may encounter through their daily lives (reading the denomination of money, reading labels, finding something that has been dropped, etc.) While they are important value-added services for the community, they are not considered key elements to making the mobile device accessible but are rather services that can help individuals with vision-related issues if the mobile device can be accessed. While these applications and services should be accessible through the mobile device, they are not directly related to the accessibility of the mobile device itself and are, therefore, outside of the scope of this document. The end goals of the user must be taken into consideration when selecting a mobile device for their needs though. Personalization and the need to achieve goals that are not directly related to the accessibility of the device are critical in preventing device abandonment.^{26, 27}

6 Definition of an Accessibility Solution

By definition, an “accessibility solution” must allow the user to complete all tasks on the primary task list using only the capabilities of that solution. “Enhancements” are technologies that can help a user complete a part (multiple steps) or a single step necessary to complete a task, but an enhancement cannot complete a full task on its own. An enhancement is used to speed up the process of completing parts of a task. Using a series of enhancements to complete a task is not considered a solution, unless that series of enhancements allows the user to complete all the tasks the user needs to complete.

Similarly, solutions cannot rely solely on enhancements to complete only some steps necessary to complete a task. Launching a navigation App using a

²⁶ Hongxin Zhao.” Predictors of Assistive Technology Abandonment”. 1993, Assistive Technology Journal. https://www.academia.edu/37423321/Predictors_of_Assistive_Technology_Abandonment

²⁷ Stefan Carmien.” Assistive Technology Abandonment: Research Realities and Potentials”. Lecture Notes in Computer Science. https://www.academia.edu/61339073/Assistive_Technology_Abandonment_Research_Realities_and_Potentials

pointing device, dictating text into the App for the city to get the map for using voice recognition and then using the pointing device to pick a point of interest on the map would be an example where a solution (the pointing device) completes some of the steps of a task (launching the App and picking a point of interest), but an enhancement (voice recognition to enter the text) completes some of the other steps in the task of navigating to a point of interest. The solution is the pointing device as the user can launch the App, use a virtual keyboard to enter the text and pick a point of interest with only the pointing device. The voice recognition is an enhancement that only speeds up the text entry process but the solution, the pointing device, is capable of doing that step also.

7 Need For Solutions to Operate Simultaneously

8 Support for Individuals Who Have Multiple Disabilities

An individual may have multiple disabilities and as such, assistive technology (AT) solutions must be able to co-exist and operate on the same device concurrently. The five communities of users identified in this document are:

1. Mobility Loss
2. Vision Loss
3. Hearing Loss
4. Cognitive Loss
5. Speech Loss

Within each of these communities, we identified three levels of disability:

- Mild
- Moderate
- Severe

While it is difficult to cover every combination of disability, there are combinations of disabilities that are more common, and therefore will be

described explicitly. Devices provided under the procurement process should be able to support the following combination of disabilities:

- Mobility Impairment and Speech Impairment
- Mobility Impairment and Cognitive Impairment
- Hearing Impairment and Vision Impairment

Reviewers: This list is currently incomplete. Please add combinations of disabilities you feel are prevalent, with supporting statistics if possible.

Table 8. Prevalent combinations of two disability conditions.

	Mobility	Vision	Hearing	Cognitive	Speech
Mobility	X	Aging, Diabetes	Aging	Stroke	CP, MS, ALS
Vision	NA	X	Aging	Traumatic Brain Injury	Usher's Syndrome, Aging, Cerebral Palsy
Hearing	NA	NA	X	Traumatic Brain Injury	Born Deaf
Cognitive	NA	NA	NA	X	Aphasia
Speech	NA	NA	NA	NA	X

and may support the following combinations of disabilities:

For each supported disability type, all levels of severity must be supported. Device manufacturers and suppliers are encouraged to ensure the co-existence of all AT solutions that can be implemented on the mobile device if technically feasible.^{28, 29}

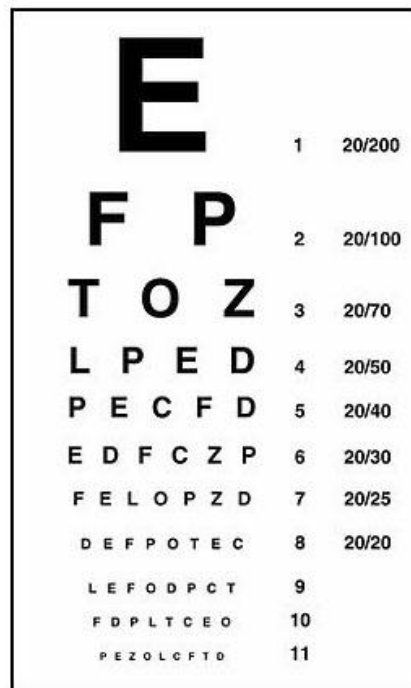
²⁸ Global Report 2018 Persons with Deafblindness and Inequality”. <https://wfdb.eu/wfdb-report-2018/deafblindness-and-inequality/>

²⁹ <https://www.nhs.uk/conditions/deafblindness/>

9 Definition of Vision Loss

Vision loss often is defined by the visual acuity that a person has. Visual acuity is a measure of how clear and sharp your vision is. To standardize this, it's measured at different distances so that the results from many people can be averaged together. It is often measured using a Snellen chart, a chart of different letters and different sizes using a sans serif font.

Using the Snellen chart vision is measured as a ratio. Standard vision is given the ratio of 20/20. The top number of the ratio is the distance the individual being tested can see the letters of a specific row of the chart with. The bottom ratio is the distance that the standard person without an acuity issue can see the specific row of letters at. So, a ratio of 20/20 means the individual can see at 20 feet what the standard person can see at 20 ft. A ratio of 20/40 means the person needs to be at 20 ft to see what the standard person can see at 40 feet.



A standard Snellen chart, with vision estimates.

9.1 Degrees of vision loss

According to the World Health Organization, The International Classification of Diseases 11 (2018) divides present-day vision impairment into two categories: distance and near.³⁰

Distance vision impairment:

Vision range	Description
6/12 – 6/18	Mild
6/18 – 6/60	Moderate
6/60 – 3/60	Severe
Less than 3/60	Blindness

Near vision impairment:

- Near visual acuity worse than N6 or M.08 at 40cm.

The segmentation of levels of severity can be subjective and can vary slightly depending on the organization but they follow similar major trends.

The following categories of vision impairment are used by the World Health Organization, when the best glasses correction for the superior eye's vision is available:³¹

Table 9. A severity classification of visual disability according to the World Health Organization.

Vision range	Description
20/30 – 20/60	Mild vision disability; near-normal vision

³⁰ <https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment>

³¹ Carmen Willings. "Vision Classifications." May 25, 2019. <https://www.teachingvisuallyimpaired.com/vision-classifications.html#:~:text=20/30%20to%2020/60%20is%20considered%20mild%20vision%20loss,in%20the%20BETTER%20eye%20is%20considered%20legally%20blind.> Downloaded March 21 2021

20/70 – 20/160	Moderate vision disability; moderate low vision
20/200 – 20/400	Severe vision disability; severe low vision (in the US, anyone with 20/200 in the better is considered legally blind)
20/500 – 20/1000	Profound vision disability; profound low vision
Less than 20/1000	Near-total vision disability; near-total blindness
No light perception	Total vision disability; total blindness

There are various degrees of visual impairment based on the loss of the visual field (peripheral vision loss). A person is deemed legally blind in the US if they have a residual vision field loss of 20 degrees or less.³²

Common causes that lead to vision loss or visual impairment include injury to the eye, inherited conditions, and infections. This can result in loss of visual acuity, partial loss of some of the field of view (loss of the centre region or peripheral region are examples), clouding of the lenses of the eyes or total vision loss.

9.2 Causes of Vision Loss

The most common classes of vision impairment are:

- Central vision impairment – blind spot in the center of vision.
- Peripheral vision impairment – the inability to perceive objects above, below, or to either side of eye level. Central vision, however, remains intact.
- Nocturnal blindness – the inability to see in dimly lit spaces like theatres and at night outside.
- Blurry vision – both close-up and distant objects appear blurry.
- Hazy vision – there appears to be a film or glare covering the entire field of view³³

³² Carmen Willing, “Vision Classifications.” <https://www.teachingvisuallyimpaired.com/vision-classifications.html>.

³³ <https://my.clevelandclinic.org/health/diseases/8585-low-vision>

- Color blindness – makes it hard to tell the difference between certain colors³⁴
- Photophobia – an extreme sensitivity to light³⁵

Most common causes of vision impairment include:

- Eye injuries
 - Injuries to the cornea are the most common cause within this class
- Inherited conditions of blindness and vision impairment
 - Retinitis pigmentosa is the most common cause of inherited blindness
- Eye infections
 - Prenatal viral infections in a pregnant person (e.g., German measles) can be transmitted to fetus, causing congenital blindness or visual impairment in the newborn
 - Trachoma due to Chlamydia trachomatis can damage eyesight
- Amblyopia
 - Impaired vision in one eye due to lack of use in early childhood
- Cataracts
 - Vision impairment due to clouding of part or the entire lens of the eye and consequent obstruction of light that focuses on the retina
- Diabetic retinopathy
 - Vision impairment due to damaged small blood vessels in the retina
- Glaucoma
 - Vision impairment due to raised pressure within the eyes that damages the optic nerve
- Age-related Macular Degeneration
 - Progressive vision loss due to damage to the macula (the most sensitive part of the retina)³⁶

³⁴ <https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/color-blindness>

³⁵ <https://www.visioncenter.org/conditions/photophobia/>

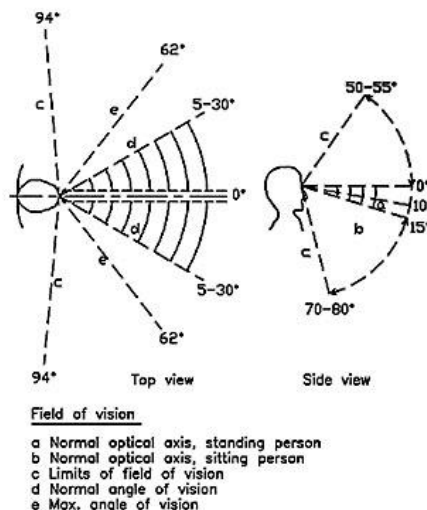
³⁶ Dr. Ananya Mandal, “Causes of visual impairment.” <https://www.news-medical.net/health/Causes-of-visual-impairment.aspx>

For low vision, logarithmic charts may be used in place of the Snellen charts (Bailey Lovie, ETDRS, or Thomas).³⁷ The advantages to these charts are:

- Equal number of letters per line
- Regular spacing between lines and letters
- Uniform progression of letter size
- Final score base precisely on letters read
- Improved test/retest reliability

In addition, there are conditions that affect the visual field of view of the individual. This may show up as a black spot centre of what the person sees resulting in the loss of the central field of view. Alternatively, it could

Field of Vision



show up as a loss of peripheral vision in which case the person sees only within a small cone. Random black spots that obscure the field of view in selected areas may also be a condition experienced by a person who experiences a loss of field of view. In addition, some conditions may result in the distance at which the person's eyes can focus can be reduced, effectively reducing the distance at which the user can effectively use the mobile device.

For these standards it is assumed that the field of view is consistent with the average field of view of people without any vision related issues. Critical criteria will be derived from the assumptions laid out here and above to determine the maximum minimum font height, height of a point of interest

³⁷ <https://www.youtube.com/watch?v=9Vk5bAEwV4g>

and contrast. The minimum size setting to a point of interest is not intended to be a fixed dimension. Fonts and points of interest such as icons should be scalable up to at least the minimum recommended height. Where the individual's effective distance where they focus on the screen of the mobile device is less than the assumed maximum distance of 30 inches the desired font or point of interest height and width will actually be reduced so as to not block or exceed the field of view. What height you may need to distinguish a point of interest at 30 inches may totally block the field of view of the user at 3 inches.

Some people also have limited color vision. Though not considered a form of vision loss it does affect the perception of people that have some of the vision loss conditions described above. Most people with limited color vision cannot see specific colors. The most common form of limited color vision is red-green. This does not mean that people with this condition cannot see these colors, they simply have a harder time differentiating between them, which can depend on the darkness or lightness of the colors. Other combinations of colors that people have a hard time perceiving also exist. Another form of limited color vision is blue-yellow. Given that patients with blue-yellow insufficiency typically also experience red-green blindness, this is a more uncommon and severe kind of colour vision loss than only red-green deficiency.³⁸

People with limited color vision often see neutral or gray areas where color should appear. People who have a form of limited color vision that involves a total color deficiency have a condition called achromatopsia. They can only see things as black and white or in shades of gray. Limited color vision can range from mild to severe, depending on the cause. It affects both eyes if caused by a biological condition or just one if it is caused by injury or illness.

Limited color vision is usually inherited but certain conditions can cause limited color vision. These conditions include:

- Diabetes.
- Glaucoma.
- Macular Degeneration.
- Alzheimer's disease.

³⁸ "Color vision deficiency". American Optometric Association. [Color vision deficiency | AOA](#)

- Parkinson's disease.
- Multiple Sclerosis.
- Chronic alcoholism.
- Leukemia.
- Sickle Cell Anemia.

Another condition that affects vision loss users is light sensitivity in which bright lights hurt your eyes. Another name for this condition is photophobia.

10 Breaking Down the Users Within Each Disability Group

Within each of these 5 disability groups are people with varying levels of severity ranging from very mild to severe. By reviewing the abilities across the range of users a smaller number of types of solutions emerge. These solutions will meet the needs of users with typically only minor adjustments necessary to customize the solution to their needs.

11 Proposed Classification

Table 10. A proposed severity classification for visual disability, for the purposes of this document.

Vision range	Description
20/30 – 20/60	Mild vision disability; near-normal vision
20/70 – 20/160	Moderate vision disability; moderate low vision
20/200 – 20/400	Severe vision disability; severe low vision (in the US, anyone with 20/200 in the better is considered legally blind)
20/500 – 20/1000	Profound vision disability; profound low vision
Less than 20/1000	Near-total vision disability; near-total blindness

No light perception	Total vision disability; total blindness
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12 Principles of Technology Design for People with Vision Loss

Universal design is the process of designing environments, services, and products to be usable, insofar as possible and practical, by people with a wide range of abilities.³⁹ By employing the principles of universal design, accessibility and safety for users can be improved. An environment, product, or service will be accessible to the widest possible audience if the high-level principles are met. Generally, the broader the application of the universal design principles to products, services, and environments is, the less the need for assistive or adaptive technologies will be.

The most widely cited principles in universal design are proposed by Field et al. (2007), adapted from a publication by the Center for Universal Design in 1997.⁴⁰ These principles are outlined in **Table 11**. ‘Size and space for approach and use’ and ‘low physical effort’ are less about accommodating vision loss and more general in their applicability. However, ‘equitable use’, ‘tolerance for error’, ‘flexibility in use’, ‘simple and intuitive’, and ‘perceptible information’ are pertinent categories when designing a mobile device for people with visual disabilities.

Table 11. Principles of universal design (Center for Universal Design, 1997).

Principle	Definition of principle
Equitable use	The design is useful and marketable to people with diverse abilities.
Flexibility in use	The design accommodates a wide range of individual preferences and abilities.

³⁹ Field, M. J., Jette, A. M., & America, I. of M. (US) C. on D. in. (2007). Assistive and Mainstream Technologies for People with Disabilities. In *The Future of Disability in America*. National Academies Press (US). <https://www.ncbi.nlm.nih.gov/books/NBK11418/>

⁴⁰ Field, M. J., Jette, A. M., & America, I. of M. (US) C. on D. in. (2007). Assistive and Mainstream Technologies for People with Disabilities. In *The Future of Disability in America*. National Academies Press (US). <https://www.ncbi.nlm.nih.gov/books/NBK11418/>

Simple and intuitive	Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level
Perceptible information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
Tolerance for error	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
Low physical effort	The design can be used efficiently and comfortably and with a minimum fatigue.
Size and space for approach and use	Appropriate size and space are provided for approach, reach, manipulation, and use, regardless of the user's body, size, posture, or mobility.

The Electronic and Information Technology Access Advisory Committee (EITAAC) recommends five principles for identifying whether E&IT provides comparable accessibility to data and information of those who live with disabilities and those who do not, as per the Section 508 of the Rehabilitation Act of 1973. EITAAC cautions that agencies should take the principles into account when endeavoring to implement the requirements of Section. The principles are outlined in **Table 12**.

Table 12. *Principles of implementing the requirements in Section 508 of the Rehabilitation Act of 1973, as presented by the Electronic and Information Technology Access Advisory Committee in 1999.*

Principle	Definition of principle
Principle of user access and efficiency	Accessibility provisions allow users to independently perform tasks to the best of their abilities.
Principle of technical feasibility	Technical feasibility must be evaluated within a given procurement process. Agencies must exercise judgment and collaborate with the industry and consumers to determine when a

	requirement has become technically feasible for a particular product, service, or environment.
Principle of proportionality	No standard is applied to go beyond what is necessary to achieve its objective, to mitigate unforeseen inefficiencies and cost increases without significant benefit.
Principle of flexibility	Since different users have preferences or necessities to operate E&IT in different ways, where available, more than one accessibility option should be provided.
Principle of compatibility and adaptability	Agencies have a responsibility to ensure that E&IT and accessibility technologies are as broadly compatible as possible without creating an undue burden.

The above are high-level design principles but at the root, people with vision-related losses are dealing with the issues of whether all outputs from the mobile device are “perceivable” and “can be understood”. The issues around whether an output is perceivable center around vision-based outputs. The output can be divided into two categories:

1. Issues around vision-related communications
2. Issues around vision-based notifications

13 Contextualizing Design Principles within a Performance Metric Framework

It is possible to use the twelve design principles outlined in Section 12 to aid in the identification of appropriate best practices for each disability subgroup. It is important to use the design principles along with key performance metrics—that define the abilities of the users within the community needed to interact with that technology. Where possible, the authors distilled the abilities down to a small number of critical performance metrics that dictate the capacity of the user to successfully perform all necessary interactions for completing every primary task.

For this document, we are using the concept of “performance metrics”. Performance metrics are measurable characteristics or dimensions of a person

or process. They are typically used as an objective way to measure a person's ability to complete a task or process. There is no absolute set of performance metrics that can be used for all situations. Usually, the performance metrics are selected to represent key dimensions or characteristics of what needs to be measured for a specific task or process. In this document, the metrics have been selected to represent interactions with mobile devices. A combination of performance metrics can be used to represent the abilities of the subgroups of users within a community. Subsequently, a particular accessibility solution usually addresses one sub-group of users that share a unique combination of abilities, as described by the performance metrics. While there may be cases where a solution addresses the needs of multiple subgroups of users, the appropriateness of a solution as measured by efficiency (time to perform the task) usually helps to define the subgroup of users the solution is most appropriate for. The definition of appropriateness takes into consideration the end users' abilities so that they can complete a task in the most effective and efficient manner possible, given their abilities.

When assessing abilities of users from the vision loss community, focus is put on the five key performance metrics that define the abilities of every user. Those performance metrics are:

- Visual acuity
- Vertical field of view
- Horizontal field of view
- Color vision
- Photophobia

14 Overview of Various Technical Requirement Standards from Around the World

14.1 Standards harmonization

Accessibility standards define what characteristics or features are required for ICT technology to be accessible. These standards are used by technology developers, procurement officers, or legal compliance officials (among others) to determine if accessibility requirements for given products have been met.

The harmonization of different accessibility standards is a mutual objective of private companies, advocacy organizations, and governments. If harmonization between standards is not achieved, private companies seeking

production of accessible documents face the possibility of non-conformance with a set of standards or the necessity of producing different versions of the same product for various jurisdictions. Therefore, to achieve accessibility, consistency across standards and their individual requirements is key. The three major standards in this document—Section 508 of the U.S. Rehabilitation Act, the European Standard EN 301 549, and Web Content Accessibility Guidelines 2—are harmonized. While Section 508 standards incorporate WCAG 2.0 with respect to web and software, the EU standards were developed to avoid any conflicts with Section 508 and WCAG 2.0. Section 508 and EN 301 549 are standards; they have been adopted by the U.S. and by the European Union as the governing standards for implementation of ICT accessibility requirements. WCAG 2.0 is referred to as a guideline, developed through a process involving many stakeholders by the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C). The W3C does not necessitate accessibility, but rather puts out standards through a consensus process for adoption by external bodies, such as governments or tech companies.

A spreadsheet comparing the various standards can be found at: [Unified ICT Accessibility Standards Compilation - download folder - Google Drive](#) The government of Canada is moving toward endorsing the EN 301 549 standard for its procurement process. This document is using EN 301 549 as the reference and adding modifications, additions and subtractions from the standard to account for the difference between generic ICT designs and mobile device designs. Refer to Section 15.1 for a list of the modifications, additions, and submissions as it applied to this specific group of users.

14.2 Functional performance statements

In this section, functional performance statements of Section 508 38 of the U.S. Rehabilitation Act and European Standard EN 301 549 39 are outlined. Functional performance statements are high-level statements that use simple terms to describe the functional performance thresholds necessary to be in place for users with disabilities to be able to locate, identify, and operate ICTs, and to access provided information, regardless of physical, cognitive, or sensory abilities. While there are differences between the American Section 508 and the European EN 301 549 guidelines/standards in terms of verbiage, specifications, and, to a degree, scope, both guidelines/standards put the user at the core of establishing whether a product or service can be located, identified, and operated by persons with or without

disabilities. Therefore, both standards contain nearly identical functional performance statements.

14.2.1 *Functional Performance Statements in EN 301 549*

The statements set out in Clause 4 of EN 301 549 are intended to describe the functional performance of ICT enabling people to locate, identify, and operate ICT functions, and to access the information provided, regardless of their abilities. Any disability may be permanent, temporary, or situational. The Functional Performance Statements address, in a simple way, the set of user accessibility needs. They describe the capabilities of how persons with disabilities can interact with an ICT product or service, and the features that the ICT needs to provide when a capability is not available for use. However, the Functional Performance Statements are very high-level, and as such do not contain the necessary detailed and testable requirements.

14.2.1.1 *4.2.1 Usage without vision*

Where ICT provides visual modes of operation, the ICT provides at least one mode of operation that does not require vision. This is essential for users without vision and benefits many more users in different situations.

NOTE 1: A web page or application with a well-formed semantic structure can allow users without vision to identify, navigate and interact with a visual user interface.

NOTE 2: Audio and tactile user interfaces may contribute towards meeting this clause.

14.2.1.2 *4.2.2 Usage with limited vision*

Where ICT provides visual modes of operation, the ICT provides features that enable users to make better use of their limited vision. This is essential for users with limited vision and benefits many more users in different situations.

NOTE 1: Magnification, reduction of required field of vision and control of contrast, brightness and intensity can contribute towards meeting this clause.

NOTE 2: Where significant features of the user interface are dependent on depth perception, the provision of additional methods of distinguishing between the features may contribute towards meeting this clause.

NOTE 3: Users with limited vision may also benefit from non-visual access (see clause 4.2.1)

14.2.2 W3C WCAG 2.1

The Web Content Accessibility Guidelines (WCAG 2.1) define how to make web content accessible to people with disabilities. It is worth noting that despite its recent release, WCAG 2.1 has been integrated into the updated version of EN 301 549. The specifications in EN 301 549 reference both WCAG 2.0 and WCAG 2.1 for Web content, and it aligns with WCAG 2.1 for non-Web documents and software.

15 Comparison of Technical Accessibility Requirements

Section 508 of the U.S. Rehabilitation Act and European Standard EN 301 549 both contain many technical accessibility requirements, which offer details that go beyond the high-level functional performance statements. Technical accessibility requirements should describe objective and measurable outcomes for ICTs, without being overly prescriptive. In order to meet a high-level performance statement, an ICT solution must conform to all relevant technical accessibility requirements.

It has been proposed that EN 301 549 should be adopted as the generic, accessible information and communication technology (ICT) standard for all ICT for the government of Canada. Though not official approved as of the writing of this document EN 301 549 potentially will form the baseline specification for any procurement of ICT for the government of Canada when approved. A working group is currently being formed by Accessibility Standards Canada.

The section of the document will highlight exceptions (additions, changes and omissions) being proposed specifically for mobile devices to the individual EN 301 549 requirements as mobile devices are a distinct sub-category of ICT that may not require all the specific individual requirements, may require additional specifications or may require modified version of specification within EN 301 549 standard.

This section is also intended to provide a quick summary of changes being proposed for the modified EN 301 549 standard as it is applied to mobile devices. This section is being provided specifically for procurement staff and regulatory staff from mobile device manufacturers that are tasked with keeping up with new standards. It is important that procurement and regulatory staff also look at how the standards and the exceptions are applied in the proposed procurement process discussed below in Section xxx.

15.1 Checklist of Differences Between Standards

It has been proposed that EN 301 549 should be adopted as the generic, accessible information and communication technology (ICT) standard for all ICT for the government of Canada. Though not officially approved as of the writing of this document, EN 301549 will form the baseline specification for a procurement of ICT for the government of Canada, when approved.

Section 15.1 of the document will highlight exceptions (additions, changes and omissions) being proposed specifically for mobile devices to the individual EN 301 549 requirements, as mobile devices are a distinct sub-category of ICT that may not require all the specific individual requirements, may require additional specifications, or may require modified version of specification within the EN 301 549 standard.

This section is also intended to provide a summary of changes being proposed for the modified EN 301 549 standard as it is applied to mobile devices. This section is being provided specifically for procurement and regulatory staff from mobile device manufacturers that are tasked with keeping up with new standards. It is important that procurement and regulatory staff also look at how the standards and the exceptions are applied in the proposed procurement process discussed below in Section xx. For information on where the recommendations originate, refer to the Technical Discussion under each Best Practice for each persona. The recommendations are presented here without reference to the specific personas and best practices that they apply to, to keep this part of the document focused and improve clarity.

15.1.1 *Modifications*

- No modifications.

15.1.2 *Additions*

Addition	Comments
The height of the default system font must be a height of at least 0.33 inches for the letter “H” for a closed system and adjusted up to at least a height of 0.33 inches for the letter “H” for an open system.	For mobile devices, the maximum distance that the phone will be positioned relative to the user is the equivalent of an arm’s length. The average maximum arm’s length based on anthropometric studies is 0.68 metres. Refer to Appendix C. This is a modification of EN 301 549 paragraph: 5.1.4 Functionality closed to text enlargement Where any functionality of ICT is closed to the text enlargement features of platform or assistive technology, the ICT shall provide a mode of operation where the text and images of text necessary for all functionality is displayed in such a way that a non-accented capital "H" subtends an angle of at least 0,7 degrees at a viewing distance specified by the supplier.

15.1.3 *Deletions*

No deletions.

16 Best Practices Background

The best practices proposed in this document demonstrate methods of interactions that adhere to the above principles. These examples are being provided to show that it is possible to implement effective solutions that meet the accessibility criteria and may sometimes be desirable to other users.

The main challenge for people with vision loss is perceiving the content generated as output on mobile devices and the controls on the device. The best practices for this disability group involve enhancing the content that is provided or generated or providing it in alternative formats which are typically in an audio form as opposed to a visual form. The best practices will be divided between output and input sections. Outputs refer to the points of interest on the mobile device screen that need to be perceived in order for the user to complete a task on the device. Input refers to interactions with points of interest on the device including interacting with and selecting points of interest as well as entering text into points of interest if required as part of their interaction (text fields, URL fields, etc.)

17 Personas

One of the most effective ways to communicate the needs of specific groups of users is by using personas. A persona assumes a defined set of characteristics about a set of users. A fictional person is used to represent the goals, motivations, capabilities, and lifestyle characteristics of a group of users. Personas allow designers and procurement managers to understand the needs of the end users by simplifying their issues. Rather than having thousands or millions of individual end users, end users are categorized into a smaller number of end user groups with common characteristics. In most cases, personas are created from data collection via interviews with users. They are captured in one- to two-page descriptions that include behaviour patterns, goals, skills, attitudes, and the environment, with a few personal details to make the persona realistic and relatable.

Use cases describe the responses of a product or service to a series of related requests from an end user. A use case covers a common task that the user may try to achieve through the product or service. Together, personas and use cases help to guide decisions about a product or service, such as features, interactions, and visual or acoustic design. These tools are important to

designers and procurement managers as they help to define who will use the product or service to complete the end goal. In the case of mobile devices, it is the use of advanced communication services. The use cases are the tasks in the primary task list above.

Below are personas for mild, moderate, and severe levels of vision loss. Each persona provides a background on a user that can benefit from specific classes of solutions. After each persona is a list of “best practices” or classes of solutions that would benefit a user with that specific set of abilities. Note that to qualify to be a best practice, the user must be able to complete all tasks in the primary task list, detailed in Section xx of this document. Described with the best practice, where relevant, is a list of enhanced features. “Enhanced Features” are accessibility features that allow the user to interact with some but not all tasks on the primary task list, or only complete some steps of the process necessary to complete a task. Voice Assistants for example is an enhanced feature because you cannot perform all the tasks on the primary task list. You can dictate and send a text message using a voice assistant, for example, but you cannot go to a web page and navigate through that webpage to complete a video meeting using a voice assistant. In addition, individual interactions like scrolling through a long webpage or picking an arbitrary point of interest on a webpage are examples of actions a user can not perform with a Voice Assistant.

Within each “Best Practice” section is a “Technical Discussion” section. In this section, any technical requirements necessary to implement the Best Practice is discussed. Where possible, the authors have tried to avoid referring to specific implementations on specific platforms. Rather, the authors have tried to describe a set of generic features that users have come to expect for the class of Best Practice. Note that most of these best practices currently exist on one or more models of a mobile device or brand of mobile device. There are a handful of best practices that have been attempted but are not considered a complete solution yet. In those cases, the Best Practice describes features and operational procedures of the solution that would define when the solution is complete and appropriate for the end user.

Also outlined for each best practice is the mapping of the best practices back to the relevant specifications from the European EN 301 549 standard. As that standard is being considered the generic standard for Information and Communication Technology in Canada for the federal government, mobile devices will have to conform to many of those specifications. The mapping is

being provided to demonstrate how each best practice would conform to a procurement process based around the EN 301 549 standard. Most mobile device manufacturers that sell in global markets should be familiar with this established standard. There are additions, modifications, and deletions to the standard as it applies to mobile devices, and the details of those additions, modifications, and deletions are broken out in Section 15.1.

For simplicity of this document, we are referring only to the loss of visual acuity in this document to classify users as having a mild, moderate, or severe level of vision disability. Depending on the visual acuity of the remaining field of vision, similar solutions would also apply to those individuals that have a condition that results in the loss of field of vision. Below, we discuss the personas for mild, moderate, and severe levels of vision-related issues.

18 Mild Vision Loss Persona



18.1 Performance Metrics

Table 13. Performance metrics for mild vision disability persona.

Performance Metric	Value
Visual Acuity	● 20/50 vision or better

	● Can see letters if they are 2.2 mm or bigger at 60 cm without the aid of any assistive technology (refer to Appendix A) ● Note: Also refer to font height recommendation for people with mobility impairments as their viewing distance is typically further away if looking for one recommendation to cover multiple disability communities.
Field of View Vertical	● 15 degrees vertical
Field of View Horizontal	● 30 degrees from the centre line of the face in the horizontal direction left and right
Color Vision	● Limited color vision ● Red/green color blindness ⁴¹
Contrast	● Can see lettering if the luminance contrast ratio is greater than 4.5:1 (as measured on a contrast checker comparing the foreground font color and background color)
Photophobia	● Yes
Hearing	● Has average hearing
Range of Mobility	● Full function of the hands, wrists, arms
Braille usage	● Cannot read or write Braille

18.2 Use Case

Color perception impairment with age-related farsightedness and mild visual acuity impairment with light sensitivity.

Mild vision loss is also referred to as low vision. A formal definition of low vision can be seen here: <https://my.clevelandclinic.org/health/diseases/8585-low-vision>]

- 20/30 to 20/60 is considered mild vision loss, or near-normal vision⁴²

Frank (63) has Protanopia, Presbyopia, and early Cataracts. Protanopia causes Frank to have problems seeing the color red. Presbyopia is the gradual loss of your eyes' ability to focus on nearby objects. It usually happens to everyone as they age and becomes noticeable in your early to mid-40s and continues to worsen until around age 65.⁴³ Cataracts are the clouding of the lens of your eye, which is normally clear. Most cataracts develop slowly over time, causing symptoms such as blurry vision. A more formal definition of cataract is available from the Mayo Clinic.⁴⁴ The farsightedness can be corrected with reading glasses, but the blurriness from early Cataracts is starting to reduce acuity at all distances. The cataracts are causing a sensitivity to light and a need for greater contrast.

Frank is an executive at a Fortune 500 company. He has always had trouble distinguishing between some shades of red and green, but rarely mentions it. He is hesitating on Cataract surgery since he is currently “too busy” and it is “not that bad” so far, but he is using various accommodations.

Those close to Frank have long known to avoid use or mention of color to differentiate content. And his team has learned that red/yellow/green for a scorecard needs to also be supplemented with shapes. For most presentations, he has asked his team to use a template with a dark background so he can avoid the “glare” from presentations using the old template. He limits his rare driving to daytime and demonstrates his “environmental conscience” by walking and taking public transportation when he is not away on business.

To reduce use of his reading glasses (that are working less well with cataracts), he makes use of large font and dark theme settings on his mobile devices. He uses the voice assistant extensively to make calls, reply to texts, compose short email replies, and other simple tasks.

⁴² Carmen Willings. “Vision Classifications.” May 25, 2019.

<https://www.teachingvisuallyimpaired.com/vision-classifications.html#:~:text=20/30%20to%2020/60%20is%20considered%20mild%20vision%20loss,,in%20the%20BETTER%20eye%20is%20considered%20legally%20blind.> Downloaded March 21 2021

⁴³ “Presbyopia”. Mayo Clinic. [Presbyopia - Symptoms and causes - Mayo Clinic](#)

⁴⁴ [Cataracts - Symptoms and causes - Mayo Clinic](#)

18.3 Best Practices for Mild Vision Loss

Persons with a mild vision disability benefit from alternative ways of perceiving and interacting with content generated as an output on mobile devices, usually in the form of audio as opposed to visual form. Classes of best practices for moderate hearing disability include:

1. Outputs
2. Inputs

18.3.1 Technical Discussion for ‘Outputs’

As specified in the personas above, this group of users typically requires larger fonts and points of interest heights and widths to make it easier for the user to perceive the outputs on the device screen. The recommendation for the minimum large font size and point of interest height specified above represent the lowest value of the maximum height and width for point of interest elements. Higher values of heights and width may be used. The point of interest height and contrast should be variable so the user can customize the point of interest elements to achieve comfortable and easy perception.

To ensure that an increase in font size is “big enough”, the font size specified in Appendix C is adopted here. The standard described is for fonts on a system that do not provide for user adjustment of font size. On a device that does allow user specification, the default is expected to be smaller than this size, and a setting is available that enables adjustment to at least the size specified in Appendix C. The guidance provided in Appendix C comes from the EN 301 549 standard.

Increasing the system font to make the text more readable is only one part of the solution. Changing that setting typically changes the font size and style for the content support within each of the applications. It typically does not change the font size or style for the menus within the applications and the font size or style of buttons, labels and static text content (text content that does not change) within the applications. The text within icons is also not changed.

18.3.1.1 Relevant Specifications from Standards for ‘Outputs’

Instead of the font size adjustment specified in many standards of 200%, we require a setting that achieves the font size described in Appendix C.

Note that standards for “closed functionality” are included below to incorporate scenarios described by EN 301 549, 5.1.1 as “functionally closed”. In this case “functionally closed” is interpreted to mean a scenario that provides no user choice of AT (of the same type) and the application and platform are provided by the same supplier.

Technical standard reference	Conformance specification	Comments
4.2.2 Usage with limited vision	Where ICT provides visual modes of operation, the ICT provides features that enable users to make better use of their limited vision. This is essential for users with limited vision and benefits many more users in different situations. NOTE 1: Magnification, reduction of required field of vision and control of contrast, brightness and intensity can contribute towards meeting this clause. NOTE 2: Where significant features of the user interface are dependent on depth perception, the provision of additional methods of distinguishing between	

	the features may contribute towards meeting this clause. NOTE 3: Users with limited vision may also benefit from non-visual access (see clause 4.2.1).	
4.2.3 Usage without perception of colour	Where ICT provides visual modes of operation, the ICT provides a visual mode of operation that does not require user perception of colour. This is essential for users with limited colour perception and benefits many more users in different situations. NOTE: Where significant features of the user interface are colour-coded, the provision of additional methods of distinguishing between the features may contribute towards meeting this clause.	
4.2.11 Privacy	Where ICT provides features for accessibility, the ICT maintains the privacy of users of these features at the same level as other users. NOTE: Enabling the connection of personal headsets for private listening, not providing a spoken version of characters being masked	

		and enabling user control of legal, financial, and personal data are examples of design features that may contribute towards meeting this clause.	
5.1.6.1	Operation without keyboard interface (closed functionality)	Where ICT functionality is closed to keyboards or keyboard interfaces, all functionality shall be operable without vision as required by clause 5.1.3.	
5.1.6.2	Operation without keyboard interface (Input focus)	Where ICT functionality is closed to keyboards or keyboard interfaces and where input focus can be moved to a user interface element, it shall be possible to move the input focus away from that element using the same mechanism, in order to avoid trapping the input focus.	
5.2	Activation of accessibility features	Where ICT has documented accessibility features, it shall be possible to activate those documented accessibility features that are required to meet a specific need without relying on a method that does not support that need.	

5.4 Preservation of accessibility information during conversion	Where ICT converts information or communication it shall preserve all documented non-proprietary information that is provided for accessibility, to the extent that such information can be contained in or supported by the destination format.	
5.5.2 Operable part discernibility	Where ICT has operable parts, it shall provide a means to discern each operable part, without requiring vision and without performing the action associated with the operable part. NOTE: One way of meeting this requirement is by making the operable parts tactilely discernible.	
5.6.1 Tactile or auditory status	Where ICT has a locking or toggle control and the status of that control is visually presented to the user, the ICT shall provide at least one mode of operation where the status of the control can be determined either through touch or sound without operating the control.	

	NOTE 1: Locking or toggle controls are those controls that can only have two or three states and that keep their state while being used. NOTE 2: An example of a locking or toggle control is the "Caps Lock" key found on most keyboards. Another example is the volume button on a pay telephone, which can be set at normal, loud, or extra loud volume.	
7.2.1 Audio description playback	Where ICT displays video with synchronized audio, it shall provide a mechanism to select and play available audio description to the default audio channel. Where video technologies do not have explicit and separate mechanisms for audio description, an ICT is deemed to satisfy this requirement if the ICT enables the user to select and play several audio tracks. NOTE 1: In such cases, the video content can include the audio description as one of the available audio tracks. NOTE 2: Audio descriptions in digital	ICT with video capabilities section start

	media sometimes include information to allow descriptions that are longer than the gaps between dialogue. Support in digital media players for this "extended audio description" feature is useful, especially for digital media that is viewed personally.	
7.2.2 Audio description synchronization	Where ICT has a mechanism to play audio description, it shall preserve the synchronization between the audio/visual content and the corresponding audio description.	
7.2.3 Preservation of audio description	Where ICT transmits, converts, or records video with synchronized audio, it shall preserve audio description data such that it can be played in a manner consistent with clauses 7.2.1 and 7.2.2.	
7.3 User controls for captions and audio description	Where ICT primarily displays materials containing video with associated audio content, user controls to activate subtitling and audio description shall be	

	provided to the user at the same level of interaction (i.e. the number of steps to complete the task) as the primary media controls. NOTE 1: Primary media controls are the set of controls that the user most commonly uses to control media. NOTE 2: Products that have a general hardware volume control, such as a telephone, or a laptop which can be configured to display video through software but which is not its primary purpose, would not need dedicated hardware controls for captions and descriptions; however software controls, or hardware controls mapped through software, would need to be at the same level of interaction. NOTE 3: It is best practice for ICT to include additional controls enabling the user to select whether captions and audio descriptions are turned on or off by default.	
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8.1.2 connections	Standard	Where an ICT provides user input or output device connection points, the ICT shall provide at least one input and/or output connection that conforms to an industry standard non-proprietary format, directly or through the use of commercially available adapters. NOTE 1: The intent of this requirement is to ensure compatibility with assistive technologies by requiring the use of standard connections on ICT. NOTE 2: The word connection applies to both physical and wireless connections. NOTE 3: Current examples of industry standard non-proprietary formats are USB and Bluetooth.	Hardware Start	Section
8.4.1 Numeric keys		Where provided, physical numeric keys arranged in a rectangular keypad layout shall have the number five key tactilely distinct from the other keys of the keypad. NOTE: Recommendation ITU-T E.161 [i.20] describes the	This is a limited case in most phones today except for feature phones and a handful of phones with physical keypads.	

	12-key telephone keypad layout and provides further details of the form of tactile markers.	
11.1.1.1.1 Non-text content (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy WCAG 2.1 Success Criterion 1.1.1 Non-text Content. NOTE: CAPTCHAs do not currently appear outside of the Web. However, if they do appear, this guidance is accurate.	Software section start
11.1.1.1.2 Non-text content (closed functionality)	1Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.6 (Speech output for non-text content).	
11.1.2.1.1 Audio-only and video-only (pre-recorded - open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading and where pre-recorded auditory	

	information is not needed to enable the use of closed functions of ICT, it shall satisfy the WCAG 2.1 Success Criterion 1.2.1 Audio-only and Video-only (Prerecorded). NOTE: The alternative can be provided directly in the software - or provided in an alternate version that meets the success criterion.	
11.1.2.1.2.2 Pre-recorded video-only (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.7 (Speech output for video information).	
11.1.2.3.1 Audio description or media alternative (pre-recorded - open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.2.3 Audio Description or Media Alternative (Prerecorded). NOTE 1: The WCAG 2.1 definition of "audio description" says that "audio description" is	

		"also called 'video description' and 'descriptive narration'". NOTE 2: Secondary or alternate audio tracks are commonly used for this purpose.	
11.1.2.3.2	Audio description or media alternative (pre-recorded - closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.7 (Speech output for video information).	
11.1.2.5	Audio description (pre-recorded)	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.2.5 Audio Description (Prerecorded). NOTE 1: The WCAG 2.1 definition of "audio description" says that audio description is "Also called 'video description' and 'descriptive narration'". NOTE 2: Secondary or alternate audio tracks are commonly used for this purpose.	
11.1.3.1.1	Info and relationships (open functionality)	Where ICT is non-web software that provides a user interface and that	

	supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.3.1 Info and Relationships. NOTE: In software, programmatic determinability is best achieved through the use of accessibility services provided by platform software to enable interoperability between software and assistive technologies and accessibility features of software. (see clause 11.5 Interoperability with assistive technology).	
11.1.3.1.2 Info and relationships (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading and where information is displayed on the screen, the ICT should provide auditory information that allows the user to correlate the audio with the information displayed on the screen. NOTE 1: Many people who are legally blind still have visual ability, and use aspects of the visual display even if it	

	cannot be fully comprehended. An audio alternative that is both complete and complementary includes all visual information such as focus or highlighting, so that the audio can be correlated with information that is visible on the screen at any point in time. NOTE 2: Examples of auditory information that allows the user to correlate the audio with the information displayed on the screen include structure and relationships conveyed through presentation.	
11.1.3.2.1 Meaningful sequence (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.3.2 Meaningful Sequence.	
11.1.3.3 Sensory characteristics	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.3.3 Sensory Characteristics.	

11.1.4.1 Use of colour	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.4.1 Use of Color.	Color vision loss
11.1.4.2 Audio control	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criterion: If any audio in a software plays automatically for more than 3 seconds, either a mechanism is available to pause or stop the audio, or a mechanism is available to control audio volume independently from the overall system volume level. NOTE 1: Since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software, all content in the software (whether or not it is used to meet other success criteria) shall meet this success criterion. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.2 Audio Control replacing "on a Web page" with "in a	

	software", "any content" with "any part of a software", "whole page" with "whole software", "on the Web page" with "in the software", removing "See Conformance Requirement 5: Non-Interference" and adding note 1.	
11.2.1.1.1 Keyboard (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to keyboards or a keyboard interface, it shall satisfy the WCAG 2.1 Success Criterion 2.1.1 Keyboard. NOTE: This does not imply that software is required to directly support a keyboard or "keyboard interface". Nor does it imply that software is required to provide a soft keyboard. Underlying platform software may provide device independent input services to applications that enable operation via a keyboard. Software that supports operation via such platform device independent services	

	would be operable by a keyboard and would comply.	
11.2.1.1.2 Keyboard (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to keyboards or keyboard interface, it shall meet requirement 5.1.6.1 (Operation without keyboard interface: Closed functionality).	
11.2.1.2 No keyboard trap	Where ICT is non-web software that provides a user interface, it shall satisfy the success criterion in Table 11.3.	
11.2.2.1 Timing adjustable	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For each time limit that is set by the software, at least one of the following is true: • Turn off: The user is allowed to turn off the time limit before encountering it; or • Adjust: The user is allowed to adjust the time limit before encountering it over a wide range that is at least ten times the length of	

	the default setting; or • Extend: The user is warned before time expires and given at least 20 seconds to extend the time limit with a simple action (for example, "press the spacebar"), and the user is allowed to extend the time limit at least ten times; or • Real-time Exception: The time limit is a required part of a real-time event (for example, an auction), and no alternative to the time limit is possible; or • Essential Exception: The time limit is essential and extending it would invalidate the activity; or • 20 Hour Exception: The time limit is longer than 20 hours. NOTE 1: This success criterion helps ensure that users can complete tasks without unexpected changes in content or context that are a result of a time limit. This success criterion should be considered in conjunction with WCAG 2.1 Success Criterion 3.2.1, which puts limits on changes of	
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	content or context as a result of user action. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 2.2.1 Timing Adjustable replacing "the content" with "software" and with the words "WCAG 2.1" added before the word "Success Criterion" in note 1 above.	
11.2.2.2 Pause, stop, hide	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For moving, blinking, scrolling, or auto-updating information, all of the following are true: • Moving, blinking, scrolling: For any moving, blinking or scrolling information that (1) starts automatically, (2) lasts more than five seconds, and (3) is presented in parallel with other content, there is a mechanism for the user to pause, stop, or hide it unless the movement, blinking, or scrolling is part of an activity where it is essential; and • Auto-updating: For any	

	auto-updating information that (1) starts automatically and (2) is presented in parallel with other content, there is a mechanism for the user to pause, stop, or hide it or to control the frequency of the update unless the auto-updating is part of an activity where it is essential. NOTE 1: For requirements related to flickering or flashing content, refer to WCAG 2.1 Guideline 2.3. NOTE 2: This success criteria is applicable to all content in the software (whether or not there is an alternate accessible mode of operation of the software) since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software (including a user interface element that enables the user to activate the alternate accessible mode of operation). NOTE 3: Content that is updated periodically by software or that is	
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	streamed to the user agent is not required to preserve or present information that is generated or received between the initiation of the pause and resuming presentation, as this may not be technically possible, and in many situations could be misleading to do so. NOTE 4: An animation that occurs as part of a preload phase or similar situation can be considered essential if interaction cannot occur during that phase for all users and if not indicating progress could confuse users or cause them to think that content was frozen or broken. NOTE 5: This is to be applied to all content. Any content, whether informative or decorative, that is updated automatically, blinks, or moves may create an accessibility barrier. NOTE 6: This success criterion is identical to the WCAG 2.1 Success Criterion 2.2.2 Pause, Stop, Hide replacing	
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	"page" and "Web page" with "software", removing "See Conformance Requirement 5: Non-Interference" in note 2 of the success criterion, with the words "WCAG 2.1" added before the word "Guideline" in note 1 above, with note 2 above re-drafted to avoid the use of the word "must" and with the addition of note 5 above.	
11.2.4.3 Focus order	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: If software can be navigated sequentially and the navigation sequences affect meaning or operation, focusable components receive focus in an order that preserves meaning and operability. NOTE: This success criterion is identical to the WCAG 2.1 Success Criterion 2.4.3 Focus order replacing "Web page" with "software".	

11.2.4.4 Link purpose (in context)	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 2.4.4 Link Purpose (In Context).	
11.2.4.6 Headings and labels	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 2.4.6 Headings and Labels. NOTE: In software, headings and labels are used to describe sections of content and controls respectively. In some cases it may be unclear whether a piece of static text is a heading or a label. But whether treated as a label or a heading, the requirement is the same: that if they are present they describe the topic or purpose of the item(s) they are associated with.	
11.2.4.7 Focus visible	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 2.4.7 Focus Visible.	

11.2.5.4 Motion actuation	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 2.5.4 Motion Actuation.	
11.3.1.1.1 Language of software (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the following success criteria: The default human language of software can be programmatically determined. NOTE 1: Where software platforms provide a "locale / language" setting, applications that use that setting and render their interface in that "locale / language" would comply with this success criterion. Applications that do not use the platform "locale / language" setting but instead use an accessibility-supported method for exposing the human language of the software would also comply with this success criterion. Applications implemented in	

	technologies where assistive technologies cannot determine the human language and that do not support the platform "locale / language" setting may not be able to meet this success criterion in that locale / language. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 3.1.1 Language of page, replacing "each web page" with "software" and with the addition of note 1 above.	
11.3.1.1.2 Language of software (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.14 (Spoken languages).	
11.3.2.1 On focus	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.2.1 On Focus. NOTE: Some compound documents and their user agents are designed to provide significantly different viewing	

	and editing functionality depending upon what portion of the compound document is being interacted with (e.g. a presentation that contains an embedded spreadsheet, where the menus and toolbars of the user agent change depending upon whether the user is interacting with the presentation content, or the embedded spreadsheet content). If the user uses a mechanism other than putting focus on that portion of the compound document with which they mean to interact (e.g. by a menu choice or special keyboard gesture), any resulting change of context would not be subject to this success criterion because it was not caused by a change of focus.	
11.3.2.2 On input	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.2.2 On Input.	

11.3.3.1.1 identification functionality)	Error (open	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 3.3.1 Error Identification.	
11.3.3.1.2 Identification functionality)	Error (closed	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.15 (Non-visual error identification).	
11.3.3.2 Labels or instructions		Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.3.2 Labels or Instructions.	
11.3.3.3 suggestion	Error	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.3.3 Error Suggestion.	
11.3.3.4 prevention financial,	Error (legal, data)	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria:	

	For software that cause legal commitments or financial transactions for the user to occur, that modify or delete user controllable user controllable data in data storage systems, or that submit user test responses, at least one of the following is true: 1) Reversible: Submissions are reversible. 2) Checked: Data entered by the user is checked for input errors and the user is provided an opportunity to correct them. 3) Confirmed: A mechanism is available for reviewing, confirming, and correcting information before finalizing the submission. NOTE: This success criterion is identical to the WCAG 2.1 Success Criterion 3.3.4 Error Prevention (Legal, Financial, Data) replacing "web pages" with "software".	
11.4.1.1.1 Parsing (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to any	

	assistive technologies, it shall satisfy the success criteria: For software that uses markup languages, in such a way that the markup is separately exposed and available to assistive technologies and accessibility features of software or to a user-selectable user agent, elements have complete start and end tags, elements are nested according to their specifications, elements do not contain duplicate attributes, and any IDs are unique, except where the specifications allow these features. NOTE 1: Start and end tags that are missing a critical character in their formation, such as a closing angle bracket or a mismatched attribute value quotation mark is not complete. NOTE 2: Markup is not always available to assistive technology or to user selectable user agents such as browsers. In such cases, conformance to this [requirement] would have no impact on	
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	accessibility as it can for web content where it is exposed. NOTE 3: Examples of markup that is separately exposed and available to assistive technologies and to user agents include but are not limited to: documents encoded in HTML, ODF, and OOXML. In these examples, the markup can be parsed entirely in two ways: (a) by assistive technologies which may directly open the document, (b) by assistive technologies using DOM APIs of user agents for these document formats. NOTE 4: Examples of markup used internally for persistence of the software user interface that are never exposed to assistive technology include but are not limited to: XUL, and FXML. In these examples assistive technology only interacts with the user interface of generated software. NOTE 5: This success criterion is identical to the WCAG 2.1 Success Criterion 4.1.1 Parsing	
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	replacing "In content implemented using markup languages" with "For software that uses markup languages, in such a way that the markup is separately exposed and available to assistive technologies and accessibility features of software or to a user-selectable user agent" with the addition of notes 2, 3 and 4 above	
11.4.1.2.1 Name, role, value (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to any assistive technologies, it shall satisfy the following success criteria: For all user interface components (including but not limited to: form elements, links and components generated by scripts), the name and role can be programmatically determined; states, properties, and values that can be set by the user can be programmatically set; and notification of changes to these items is available to user agents, including assistive	

	technologies. NOTE 1: This success criterion is primarily for software developers who develop or use custom user interface components. Standard user interface components on most accessibility-supported platforms already meet this success criterion when used according to specification. NOTE 2: For conforming to this success criterion, it is usually best practice for software user interfaces to use the accessibility services provided by platform software. These accessibility services enable interoperability between software user interfaces and both assistive technologies and accessibility features of software in standardised ways. Most platform accessibility services go beyond programmatic exposure of name and role, and programmatic setting of states, properties and values (and notification	
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		of same), and specify additional information that could or should be exposed and / or set (for instance, a list of the available actions for a given user interface component, and a means to programmatically execute one of the listed actions). NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 4.1.2 Name, Role, Value replacing the original WCAG 2.1 note with: "This success criterion is primarily for software developers who develop or use custom user interface components. Standard user interface components on most accessibility supported platforms already meet this success criterion when used according to specification." and the addition of note 2 above.	
11.4.1.3.1 messages functionality)	Status (open	Where ICT is non-web software, it shall satisfy WCAG 2.1 Success Criterion 4.1.3 Status Messages.	

11.5.2.1 Platform accessibility service support for software that provides a user interface	Platform software shall provide a set of documented platform services that enable software that provides a user interface running on the platform software to interoperate with assistive technology. Where a user interface concept corresponding to one of the clauses 11.5.2.5 to 11.5.2.17 is supported within the software environment, the platform software should support that requirement. For example, selection attributes from clause 11.5.2.14 (Modification of focus and selection attributes) may not exist in environments that do not allow selection, which is most commonly associated with copy and paste. NOTE 1: These define the minimum functionality of software providing user interfaces when using platform services. NOTE 2: In some platforms these services may be called accessibility services, but	
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	in some other platforms these services may be provided as part of the user interface services. NOTE 3: User interface services that provide accessibility support by default are considered to be part of the services provided to conform to this clause (e.g. the service for creating a new user interface element provides role, state, boundary, name and description). NOTE 4: To comply with this requirement the platform software can provide its own set of services or expose the services provided by its underlying platform layers, if those services conform to this requirement. NOTE 5: Within specific programming environments, the technical attributes associated with the user interface properties described in clauses 11.5.2.5 to 11.5.2.17 might have different names than those used within	
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		the clauses.	
11.5.2.2	Platform accessibility service support for assistive technologies	Platform software shall provide a set of documented platform accessibility services that enable assistive technology to interoperate with software that provides a user interface running on the platform software. Where a user interface concept corresponding to one of the clauses 11.5.2.5 to 11.5.2.17 is supported within the software environment, the platform software should support that requirement. For example, selection attributes from clause 11.5.2.14 (Modification of focus and selection attributes) may not exist in environments that do not allow selection, which is most commonly associated with copy and paste. NOTE 1: These define the minimum functionality available to assistive technologies when using platform services. NOTE 2: The definition of platform in clause 3.1	

	applies to software that provides services to other software, including but not limited to, operating systems, web browsers, virtual machines. NOTE 3: In some platforms these services may be called accessibility services, but in some other platforms these services may be provided as part of the user interface services. NOTE 4: Typically these services belong to the same set of services that are described in clause 11.5.2.1. NOTE 5: To comply with this requirement the platform software can provide its own set of services or expose the services provided by its underlying platform layers, if those services conform to this requirement.	
11.5.2.3 Use of accessibility services	Where the software provides a user interface it shall use the applicable documented platform accessibility services. If the documented platform accessibility services do not allow the software to	

		meet the applicable requirements of clauses 11.5.2.5 to 11.5.2.17, then software that provides a user interface shall use other documented services to interoperate with assistive technology. NOTE: The term "documented platform accessibility services" refers to the set of services provided by the platform according to clauses 11.5.2.1 and 11.5.2.2. It is best practice to develop software using toolkits that automatically implement the underlying platform accessibility services.	
11.5.2.4	Assistive technology	Where the ICT is assistive technology, it shall use the documented platform accessibility services. NOTE 1: The term "documented platform accessibility services" refers to the set of services provided by the platform according to clauses 11.5.2.1 and 11.5.2.2. NOTE 2: Assistive technology can also use	

	other documented accessibility services.	
11.5.2.5 Object information	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the user interface elements' role, state(s), boundary, name, and description programmatically determinable by assistive technologies.	
11.5.2.6 Row, column, and headers	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the row and column of each cell in a data table, including headers of the row and column if present, programmatically determinable by assistive technologies.	
11.5.2.7 Values	Where the software provides a user interface, it shall, by using the services as described in clause 11.5.2.3, make the current value of a user interface element and any minimum or maximum values of the range, if the user interface element conveys	

	information about a range of values, programmatically determinable by assistive technologies.	
11.5.2.8 Label relationships	Where the software provides a user interface it shall expose the relationship that a user interface element has as a label for another element, or of being labelled by another element, using the services as described in clause 11.5.2.3, so that this information is programmatically determinable by assistive technologies.	
11.5.2.9 Parent-child relationships	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the relationship between a user interface element and any parent or children elements programmatically determinable by assistive technologies.	
11.5.2.10 Text	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the	

	text contents, text attributes, and the boundary of text rendered to the screen programmatically determinable by assistive technologies.	
11.5.2.11 List of available actions	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make a list of available actions that can be executed on a user interface element, programmatically determinable by assistive technologies.	
11.5.2.12 Execution of available actions	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow the programmatic execution of the actions exposed according to clause 11.5.2.11 by assistive technologies. NOTE 1: In some cases, the security requirements imposed on a software product may forbid external software from interfering with the ICT product. Examples of	

	systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.13 Tracking of focus and selection attributes	Where software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make information and mechanisms necessary to track focus, text insertion point, and selection attributes of user interface elements programmatically determinable by assistive technologies.	
11.5.2.14 Modification of focus and selection attributes	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow assistive	

		technologies to programmatically modify focus, text insertion point, and selection attributes of user interface elements where the user can modify these items. NOTE 1: In some cases the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.15	Change notification	Where software provides a user interface it shall, by using the services as described in clause 11.5.2.3, notify assistive technologies about	

	changes in those programmatically determinable attributes of user interface elements that are referenced in requirements 11.5.2.5 to 11.5.2.11 and 11.5.2.13.	
11.5.2.16 Modifications of states and properties	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow assistive technologies to programmatically modify states and properties of user interface elements, where the user can modify these items. NOTE 1: In some cases, the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of military forces.	

	NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.17 Modifications of values and text	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow assistive technologies to modify values and text of user interface elements using the input methods of the platform, where a user can modify these items without the use of assistive technology. NOTE 1: In some cases the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of	

	military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.6.1 User control of accessibility features	Where software is a platform platform, it shall provide sufficient modes of operation for user control over those platform accessibility features documented as intended for users.	
11.6.2 No disruption of accessibility features	Where software provides a user interface it shall not disrupt those documented accessibility features that are defined in platform documentation except when requested to do so by the user during the operation of the software.	
11.8.1 Content technology	Authoring tools shall conform to clauses 11.8.2 to 11.8.5 to the extent that information required for accessibility is supported by the format used for the output of the authoring tool.	

11.8.2 Accessible content creation	Authoring tools shall enable and guide the production of content that conforms to clauses 9 (Web content) or 10 (Non-Web content) as applicable. NOTE: Authoring tools may rely on additional tools where conformance with specific requirements is not achievable by a single tool. For example, a video editing tool may enable the creation of video files for distribution via broadcast television and the web, but authoring of caption files for multiple formats may be provided by a different tool.	
11.8.3 Preservation of accessibility information in transformations	If the authoring tool provides restructuring transformations or re-coding transformations, then accessibility information shall be preserved in the output if equivalent mechanisms exist in the content technology of the output. NOTE 1: Restructuring transformations are transformations in which the content technology stays the same, but the	

	structural features of the content are changed (e.g. linearizing tables, splitting a document into pages). NOTE 2: Re-coding transformations are transformations in which the technology used to encode the content is changed.	
11.8.4 Repair assistance	If the accessibility checking functionality of an authoring tool can detect that content does not meet a requirement of clauses 9 (Web) or 10 (Non-web documents) as applicable, then the authoring tool shall provide repair suggestion(s). NOTE: This does not preclude automated and semi-automated repair which is possible (and encouraged) for many types of content accessibility problems.	
11.8.5 Templates	When an authoring tool provides templates, at least one template that supports the creation of content that conforms to the requirements of clauses 9 (Web) or 10 (Non-web documents) as applicable shall be	

	available and identified as such.	
12.1.1 Accessibility and compatibility features	Product documentation provided with the ICT whether provided separately or integrated within the ICT shall list and explain how to use the accessibility and compatibility features of the ICT. NOTE 1: Accessibility and compatibility features include accessibility features that are built-in and accessibility features that provide compatibility with assistive technology. NOTE 2: It is best practice to use WebSchemas/Accessibility 2.0 [i.38] to provide metadata on the accessibility of ICT. NOTE 3: The accessibility statement and help pages are both examples of the provision of product information	Documentation and Support Services start
12.1.2 Accessible documentation	Product documentation provided with the ICT shall be made available in at least one of the	

	following electronic formats: a) a Web format that conforms to the requirements of clause 9; - or b) a non-web format that conforms to the requirements of clause 10. NOTE 1: This does not preclude the possibility of also providing the product documentation in other formats (electronic, printed or audio) that are not accessible. NOTE 2: It also does not preclude the possibility of providing alternate formats that meet the needs of some specific type of users (e.g. Braille documents for blind people or easy-to-read information for persons with limited cognitive, language and learning abilities). NOTE 3: Where documentation is incorporated into the ICT, the documentation falls under the requirements for accessibility in the present document. NOTE 4: A user agent	
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	that supports automatic media conversion would be beneficial to enhancing accessibility.	
12.2.2 Information on accessibility and compatibility features	ICT support services shall provide information on the accessibility and compatibility features that are mentioned in the product documentation. NOTE: Accessibility and compatibility features include accessibility features that are built-in and accessibility features that provide compatibility with assistive technology.	
12.2.4 Accessible documentation	Documentation provided by support services shall be made available in at least one of the following electronic formats: a) a Web format that conforms to clause 9; or b) a non-web format that conforms to clause 10. NOTE 1: This does not preclude the possibility of also providing the documentation in other formats (electronic or printed) that are not accessible. NOTE 2: It also does not preclude the possibility of providing alternate	

	formats that meet the needs of some specific type of users (e.g. Braille documents for blind people or easy-to-read information for persons with limited cognitive, language and learning abilities). NOTE 3: Where the support documentation is incorporated into the ICT, the documentation falls under the requirements for accessibility in the present document. NOTE 4: A user agent that supports automatic media conversion would be beneficial to enhancing accessibility.	
8.5 Tactile indication of speech mode	Where ICT is designed for shared use and speech output is available, a tactile indication of the means to initiate the speech mode of operation shall be provided. NOTE: The tactile indication could include Braille instructions.	
11.1.4.2 Audio control	Where ICT is non-web software that provides a user interface, it shall satisfy the following	

	success criteria: If any audio in a software plays automatically for more than 3 seconds, either a mechanism is available to pause or stop the audio, or a mechanism is available to control audio volume independently from the overall system volume level. NOTE 1: Since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software, all content in the software (whether or not it is used to meet other success criteria) shall meet this success criterion. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.2 Audio Control replacing "on a Web page" with "in a software", "any content" with "any part of a software", "whole page" with "whole software", "on the Web page" with "in the software", removing "See Conformance Requirement 5: Non-Interference" and adding note 1.	
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5.1.3.3 Auditory output correlation	Where auditory output is provided as non-visual access to closed functionality, and where information is displayed on the screen, the ICT should provide auditory information that allows the user to correlate the audio with the information displayed on the screen. NOTE 1: Many people who are legally blind still have visual ability, and use aspects of the visual display even if it cannot be fully comprehended. An audio alternative that is both complete and complementary includes all visual information such as focus or highlighting, so that the audio can be correlated with information that is visible on the screen at any point in time. NOTE 2: Examples of auditory information that allows the user to correlate the audio with the information displayed on the screen include structure and relationships conveyed through presentation.	Closed functionality

5.1.4 Functionality closed to text enlargement	Where any functionality of ICT is closed to the text enlargement features of platform or assistive technology, the ICT shall provide a mode of operation where the text and images of text necessary for all functionality is displayed in such a way that a non-accented capital "H" subtends an angle of at least 0,7 degrees at a viewing distance specified by the supplier.	Text enlargement guidance
7.1.4 Captions characteristics	Where ICT displays captions, it shall provide a way for the user to adapt the displayed characteristics of captions to their individual requirements, except where the captions are displayed as unmodifiable characters. NOTE 1: Defining the background and foreground colour of subtitles, font type, size opacity of the background box of subtitles, and the contour or border of the fonts can contribute to meeting this requirement. NOTE 2: Subtitles that are bitmap images are examples of unmodifiable characters.	

8.1.3 Colour	Where the ICT has hardware aspects that use colour, colour shall not be used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element.	
11.1.3.5.1 Identify input purpose (open functionality)	Where ICT is non-web software that provides a user interface and supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.3.5 Identify Input Purpose.	Software
11.1.3.5.2 Identify input purpose (closed functionality)	Where ICT is non-web software that provides a user interface and is closed to assistive technologies, in at least one mode of operation the ICT shall present to the user, in an audio form, the purpose of each input field collecting information about the user when the input field serves a purpose identified in the WCAG 2.1 Input Purposes for User Interface Components section.	

11.1.4.3 Contrast (minimum)	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.4.3 Contrast (Minimum).	
11.1.4.4.1 Resize text (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to enlargement features of platform or assistive technology, it shall satisfy the WCAG 2.1 Success Criterion 1.4.4 Resize Text. NOTE 1: Content for which there are software players, viewers or editors with a 200 percent zoom feature would automatically meet this success criterion when used with such players, unless the content will not work with zoom. NOTE 2: This success criterion is about the ability to allow users to enlarge the text on screen at least up to 200 % without needing to use assistive technologies. This means that the application provides some means for enlarging the text 200 % (zoom or otherwise) without loss of content or functionality or that the	

	application works with the platform features that meet this requirement.	
11.1.4.4.2 Resize text (closed functionality)	Where ICT is non-web software that provides a user interface which is not able to access the enlargement features of platform or assistive technology, it shall meet requirement 5.1.4 (Functionality closed to text enlargement). NOTE: Because the text rendering support in a closed environment may be more limited than the support found in user agents for the Web, meeting the present clause in a closed environment may place a much heavier burden on the content author.	
11.1.4.5.1 Images of text (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.4.5 Images of Text.	
11.1.4.10 Reflow	Where ICT is non-web software that provides a user interface it shall satisfy the following	

	success criteria: Content can be presented without loss of information or functionality, and without requiring scrolling in two dimensions for: • Vertical scrolling content at a width equivalent to 320 CSS pixels; • Horizontal scrolling content at a height equivalent to 256 CSS pixels; Except for parts of the content which require a two-dimensional layout for usage or meaning. NOTE 1: 320 CSS pixels is equivalent to a starting viewport width of 1 280 CSS pixels wide at 400 % zoom. For non-web software which are designed to scroll horizontally (e.g. with vertical text), the 256 CSS pixels is equivalent to a starting viewport height of 1 024 px at 400 % zoom. NOTE 2: Examples of content which require two-dimensional layout are images, maps, diagrams, video, games, presentations, data tables, and interfaces	
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	where it is necessary to keep toolbars in view while manipulating content. NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.10 Reflow replacing the original WCAG 2.1 notes with notes 1 and 2, above.	
11.1.4.11 Non-text contrast	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 1.4.11 Non-text Contrast.	
11.1.4.12 Text spacing	Where ICT is non-web software that provides a user interface and that does not have a fixed size content layout area that is essential to the information being conveyed, it shall satisfy WCAG 2.1 Success Criterion 1.4.12 Text spacing.	
11.1.4.13 Content on hover or focus	Where ICT is a non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 1.4.13 Content on hover or focus.	

11.2.5.2 cancellation	Pointer Where ICT is non-web software that provides a user interface, it shall satisfy the following success success criteria: For functionality that can be operated using a single pointer, at least one of the following is true: • No Down-Event: The down-event of the pointer is not used to execute any part of the function. • Abort or Undo: Completion of the function is on the up-event, and a mechanism is available to abort the function before completion or to undo the function after completion. • Up Reversal: The up-event reverses any outcome of the preceding down-event. • Essential: Completing the function on the down-event is essential. NOTE 1: Functions that emulate a keyboard or numeric keypad key press are considered essential. NOTE 2: This requirement applies to non-web software that	
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	interprets pointer actions (i.e. this does not apply to actions that are required to operate the user agent or assistive technology). NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 2.5.2 Pointer Cancellation replacing the original WCAG 2.1 note with notes 1 and 2 above.	
11.7 User preferences	Where software is not designed to be isolated from its platform, and provides a user interface, that user interface shall follow the values of the user preferences for platform settings for: units of measurement, colour, contrast, font type, font size, and focus cursor except where they are overridden by the user. NOTE 1: Software that is isolated from its underlying platform has no access to user settings in the platform and thus cannot adhere to them. NOTE 2: For web content, the underlying platform is the user agent. NOTE 3: This does not preclude the software from having additional values for a	

	setting as long as there is one mode where the application will follow the system settings even if more restricted.	
11.2.3.1 Three flashes or below threshold	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: Software does not contain anything that flashes more than three times in any one second period, or the flash is below the general flash and red flash thresholds. NOTE 1: This success criteria is applicable to all content in the software (whether or not there is an alternate accessible mode of operation of the software) since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software (including a user interface element that enables the user to activate the alternate accessible mode of operation). NOTE 2: This success criterion is identical to the WCAG 2.1 Success	

	Criterion 2.3.1 Three Flashes or Below Threshold replacing "Web pages" with "software", "the whole page" with "the whole software", "the Web page" with "the software" and removing "See Conformance Requirement 5: Non-Interference" and with note 1 above re-drafted to avoid the use of the word "must".	
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18.3.2 *Technical Discussion for ‘Inputs’*

In regard to interacting with points of interest, this group of users typically have the dexterity to interact with points of interest such as selecting and activating icons, text boxes, and URL fields with the touch screen resources provided. The recommendation regarding minimal maximum height and width are achieved (must be adjustable to *at least* those maximum recommended heights and widths).

While this group of users can use on-screen keyboards available on a typical mobile device, some may prefer physical keyboards (either T9 or QWERTY with a joystick/puck interface) for efficiency. Examples are BlindShell⁴⁵ and the Lucia Phone (RAZ Mobility).^{46 47} Where they are using on-screen keyboards, this group requires keyboards which allow them to change the contrast between foreground and background elements with at least a 3:1 ratio. Being able to invert the foreground and background colors is also necessary. An example of this type of keyboard is the Google keyboard.⁴⁸

⁴⁵ [Products — BlindShell](#)

⁴⁶ <https://www.razmobility.com/>

⁴⁷ <https://www.youtube.com/watch?v=zTzPxlfCTc>

⁴⁸ <https://www.youtube.com/watch?v=ZrPlwIEDqW4>

On-screen keyboards with larger keys are also preferred if physical keyboards are not available. On large mobile devices (Phablets and tablets) larger full QWERTY keyboards are possible though they keys may not be large enough to accommodate the recommended large font height. Physical keyboards for computers can have keys as large as 2.5 cm high and wide to accommodate the height and width of the large size font. This is not practice for a mobile device due to the size of the resulting keyboard. Other alternative keyboard layouts that allow larger keys for more efficient interactions are the T9 keyboard, where multiple letters and numbers are represented on the familiar numeric telephone keypad. Chorded keyboard such as the Senorita ⁴⁹ ⁵⁰ ⁵¹ and the Gestype ⁵² are other alternative examples. Chorded keyboards typically use a combination of between 2 to 10 keys to encode the alphabet, numbers, and symbols. Pressing a specific combination of keys produces the desired character.

Senorita is a two-thumb virtual chorded keyboard used for mobile devices. Based on letter frequencies and the shape of the thumbs, it organizes the letters on eight keys in a single row at the device's bottom edge. It gives visual cues to do chording motions sequentially rather than simultaneously. Because of its small size and proximity to the edge of the screen, it allows for eyes-free text entering. Research into Senorita suggests that, generally, it is considered effective and simple to learn. In terms of performance, one longitudinal study found that Senorita put out an average of 14 words per minute, while another short-term study reported an average figure of 9.3 words per minute. Senorita surpasses QWERTY performance in another longitudinal study with an average of 3.7 words per minute with blind users and 5.8 words per minute with low vision users.⁵³

⁴⁹ <https://www.youtube.com/watch?v=AhMRNMMY7A0>

⁵⁰ <https://dl.acm.org/doi/abs/10.1145/3313831.3376576#:~:text=Senorita%20is%20a%20novel%20two-thumb%20virtual%20chorded%20keyboard,the%20actions%20are%20unknown%2C%20facilitating%20%22learning%20by%20doing%22.>

⁵¹ Gulnar Rakhmetulla Ahmed Sabbir Arif. Senorita: A Chorded Keyboard for Sighted, Low Vision, and Blind Mobile Users April 2020. Conference: CHI '20: CHI Conference on Human Factors in Computing Systems
https://www.researchgate.net/publication/341696846_Senorita_A_Chorded_Keyboard_for_Sighted_Low_Vision_and_Blind_Mobile_Users

⁵² <https://www.youtube.com/watch?v=LW-auK5HA8g>

⁵³ <https://dl.acm.org/doi/abs/10.1145/3313831.3376576#:~:text=Senorita%20is%20a%20novel%20two-thumb%20virtual%20chorded%20keyboard,the%20actions%20are%20unknown%2C%20facilitating%20%22learning%20by%20doing%22.>

A variation on this is Gestype.⁵⁴ In this implementation, two buttons are displayed on the screen. Left, right, up, down motions on each of the two buttons represent specific letters. By combining gestures on both buttons, more letters, numbers, and symbols can be represented.

While these keyboards are not necessarily providing a full solution, as they cannot be employed in every use case, they can be considered enhancements that improve the efficiency of the existing assistive technology. The full AT solutions are hardware keyboards, high contrast keyboards, and keyboards with large and high contrast keys. Handwriting recognition⁵⁵ and voice assistants can add extra functionality. In handwriting mode, the virtual on-screen keyboard is replaced with an entry field where the user can write the text they want to enter. The system then uses digital character recognition to convert the writing to text which is inserted in the text entry field. Voice assistant recognizes a phrase spoken by the user and launches a specific App and in some cases pre-populate field like the phone number of a contact in the case of a command to “Send a text message to Fred”. Examples of voice assistants are Google Assistant and Siri.

18.3.2.1 Relevant Specifications from Standards for ‘Inputs’

Technical standard reference	Conformance specification	Comments
EN 301 549 - 5.1.6.1 Operation without keyboard interface (closed functionality)	Where ICT functionality is closed to keyboards or keyboard interfaces, all functionality shall be operable without vision as required by clause 5.1.3.	
EN 301 549 - 5.1.6.2 Operation without	Where ICT functionality is closed to keyboards or keyboard interfaces and where input focus can be moved to a user interface element, it shall be	

⁵⁴ <https://www.youtube.com/watch?v=LW-auK5HA8g>

⁵⁵ <https://www.youtube.com/watch?v=ZrPlwIEDqW4>

keyboard interface (Input focus)	possible to move the input focus away from that element using the same mechanism, in order to avoid trapping the input focus.	
EN 301 549 - 8.4.1 Numeric keys	Where provided, physical numeric keys arranged in a rectangular keypad layout shall have the number five key tactilely distinct from the other keys of the keypad. NOTE: Recommendation ITU-T E.161 [i.20] describes the 12-key telephone keypad layout and provides further details of the form of tactile markers."	
EN 301 549 - 5.6.1 Tactile or auditory status	Where ICT has a locking or toggle control and the status of that control is visually presented to the user, the ICT shall provide at least one mode of operation where the status of the control can be determined either through touch or sound without operating the control. NOTE 1: Locking or toggle controls are those controls that can only have two or three states and that keep their state while being used. NOTE 2: An example of a locking or toggle control is the ""Caps Lock"" key found on most keyboards. Another example is the volume button on a pay telephone, which can be set at normal, loud, or extra loud volume.	
EN 301 549 - 11.2.1.1.1 Keyboard (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to keyboards or a keyboard interface, it shall satisfy the WCAG 2.1 Success Criterion 2.1.1 Keyboard. NOTE: This does not imply that software is required to directly support a keyboard or ""keyboard interface"". Nor	

	does it imply that software is required to provide a soft keyboard. Underlying platform software may provide device independent input services to applications that enable operation via a keyboard. Software that supports operation via such platform device independent services would be operable by a keyboard and would comply.	
EN 301 549 - 11.2.1.1.2 Keyboard (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to keyboards or keyboard interface, it shall meet requirement 5.1.6.1 (Operation without keyboard interface: Closed functionality).	
EN 301 549 - 11.2.1.2 No keyboard trap	Where ICT is non-web software that provides a user interface, it shall satisfy the success criterion in Table 11.3.	

18.3.3 *Enhancement Features for Mild Vision Loss*

Examples of programs that can enhance the capabilities of the larger font size are:

- Big Launcher – uses free replacement icons
- Big Font
- Big Phone
- Big SMS

Big Launcher (<http://biglauncher.com>) replaces the user interface of almost a mobile device or tablet with enlarged buttons and text. It is designed to provide maximum readability and ease of use by simplifying the presentation. It can be controlled by single touches which reduce errors. It is easily customizable to match the user's needs. It allows the user to put the shortcuts for apps, websites, contacts, widgets and more directly on the home screen. It allows the user to add more screens and access them by swiping or pushing the buttons. The user can find the apps quickly with instant search or recent apps list on the top. It hides the apps the user does not want to use to

protect users from getting lost in the navigation Big Font
<https://www.youtube.com/watch?v=Hb7QbGioUh8> created a custom
scalable font up to 1/5 of the phone screen. It also changes fonts in some Apps
that are difficult to change fonts in. It works in Facebook App. It does have
some limitations; it has problems in the File Manager App. The text of the
menu items overlaps on each other.

Big Phone (BIG Phone for Seniors - Apps on Google Play) replaces the
default phone application on the phone with a dialer with large text, large
buttons and large icons. It provides basic phone functions (including enlarged
dialer) which is accessible in a simple interface. It provides
large texts and color-coded icons help you to easily distinguish between items.
It allows quick access to the user's favorite contacts from a single menu. It
allows the user to pick up an incoming call easily thanks to the simplified call
screen.

The Big SMS ([BIG SMS for Seniors – Apps on Google Play](#)) application
is similar to Big Phone, Big SMS large font and different colors used to
display the message thread. It makes replying easily to any message with the
easy-to-use SMS editor. There is an optional full-screen SMS notification that
allows you to rapidly call back or reply to the message. Multimedia messages
(MMS) are not supported in the current implementation, but they need to be
supported in future implementation.

19 Moderate Vision Loss Persona



19.1 Performance metrics.

Table 14. Performance metrics for a moderate vision loss persona.

Performance Metric	Value
Visual Acuity	● 20/160 vision ● can see letters if they are 7.3 mm or bigger at 60 cm without the aid of any assistive technology (see Appendix A) ● Note: Also refer to font height recommendation for people with mobility impairments as their viewing distance is typically further away if looking for one recommendation to cover multiple disability communities.
Vertical Field of View	● 15 degrees vertical
Horizontal Field of View	● 30 degrees from the centre line of the face in the horizontal direction left and right
Contrast	● can see lettering if the contrast ratio is greater than 4.5:1 (as measured on a contrast checker comparing the foreground font color and background color)
Color Vision	● Not applicable
Photophobia	● No
Hearing	● Has average hearing
Range of Mobility	● Full function of the hands, arms, and wrists

19.2 Use Case

Central vision loss, light, and shape perception

Paula is in her early 30's. She is an executive at a regional bank. She has a form of Macular Degeneration. Macular Degeneration, (MD), is a condition that can cause vision loss in the area of the eye responsible for sharp, central vision. The person's eyes have problems focusing and the central area of the visual field may be fuzzy. MD is a progressive disease that primarily begins later in life (usually after the age of 55) and impedes vision, sometimes to the point of legal blindness. In Paula's case she had Juvenile Diabetes when she was younger and the effect of that condition was the Macular Degeneration. Her condition means the centre part of his vision is cloudy and she has problems with light and shape perception.

Paula is still highly active and has a hectic schedule as she still needs to attend many meetings and conference calls during her business day. She normally gets around by taxi when she needs to attend a meeting and she commutes to work every day using rapid transit. She also has an active social life as she and her husband like to go ballroom dancing.

She has a cellphone that she uses to keep in touch with the office during the day if she is out of the office at a meeting. She prefers to deal with emails while in the office. She has her secretary screen her emails and alert her of urgent emails if she is out of the office. Most colleagues know she prefers a phone call to email if the issue is urgent. She also uses email to keep in touch with her friends but has never gotten around to using social media.

19.3 Best Practices for Moderate Vision Loss

Low vision is a type of visual impairment that impedes everyday functioning and cannot be rectified with surgery, medication, or prescription eyewear. Presentations of low vision include:

- Loss of sharpness or acuity (varying from 20/70 to 20/400)
- Tunnel vision
- Near-total blindness
- Smaller field of vision
- Peripheral/central vision impairment
- Blurry vision

- Excessive light sensitivity

There is no all-encompassing assistive technology for people with low vision, as there are so many different manifestations of this impairment. However, research suggests that magnification can assist people with different low vision conditions, and especially those experiencing loss of sharpness or fuzzy vision. Magnification software can encompass other enhancements of, for example, edge, color, or contrast. People with low vision can utilize magnification with computer devices in the form of screen magnifiers (e.g., ZoomText, MAGic, Zoom, Magnifier, etc.)

19.3.1.1 Technical Discussion of ‘Screen Magnification’

A screen magnifier is a software application that increases the size of everything on the screen. A simple screen magnifier may increase the size of text, icons, and graphics by up to 20 times of the original. When installed on your computer, a screen magnifier is like having a magnifying glass hovering over your screen, enlarging everything for easy reading. For example, if a user is writing an email, the screen magnifier enlarges words as they are typed. The screen magnifier also changes views with the movement of the cursor or when using keyboard shortcuts, for example. Different magnification modes are available, where users can choose to enlarge the whole screen, or particular sections as they scroll, as well as smaller areas of interest as they move the cursor.^{56 57}

Screen magnifiers can also highlight a particular area on a screen using different colors or shading. The cursor can also be customized. When zooming in on particular words, a screen magnifier smooths out the edges for easier legibility. The screen magnifier app can also invert screen colors for reduced glare (helpful for individuals with macular degeneration).

Evaluating Screen Magnifier Programs

- Before investing in a screen magnification system, consider the following inquiries, according to the American Foundation for the Blind: Is the operating system of your computer compatible with the

⁵⁶ <https://www.boia.org/blog/screen-magnifiers-who-and-how-they-help>

⁵⁷ <https://www.boia.org/blog/screen-magnifiers-who-and-how-they-help>

- magnification software? Does the software come with enhancements for cursors?
- What is the highest level of magnification?
 - Does the screen magnifier come with [screen reading software](#)?
 - Does the screen magnifier include a setting for inverting colors?⁵⁸

A screen magnifier is very customizable, from choice of what to magnify, highlight, or sharpen, to screen size and clarity.⁵⁹

People who have low vision and use screen magnifiers (LSUs) have problems with watching digital content with frequent dynamic changes (videos, movies, etc.). LSUs have to pan and zoom rapidly in tandem with the rapidly changing content. Particularly, LSUs have to constantly monitor the various regions of interest (ROIs) and manually move their cursor to these regions, which can be difficult and impractical with a fast-paced and perhaps lengthy medium such as a video. Accessibility of videos for LSUs has not been discussed widely in literature. Existing research into screen magnifiers is mainly focused on screen magnifiers. Videos can be made accessible for people with low vision impairments with the use of accurate audio descriptions, but this is mainly a feature generally designed for blind users. Additionally, writing and embedding the audio descriptions can be a lot of work.⁶⁰

An important feature, especially when used with a touch screen, is a way to quickly “zoom out” to orient to the full screen (100%), then re-center in another part of the screen and “zoom in”. This can be achieved as simply as a gesture to turn off the magnifier, and then turn it back on with a new center as specified by the “turn on” gesture.

Magnification factor can typically be between 10 to 15 times. The exact range of magnification required and the steps between magnification settings is hard to determine because it depends on the size of the mobile device screen and the resolution of that screen. A low-resolution screen may not benefit from a high magnification factor as the screen elements can become pixelated at the high magnification level. Even at high screen resolutions at some point

⁵⁸ <https://www.boia.org/blog/screen-magnifiers-who-and-how-they-help>

⁵⁹ <https://www.boia.org/blog/screen-magnifiers-who-and-how-they-help>

⁶⁰

the magnified elements that make up the screen become too large in the mobile device screen for the user to identify what is being displayed. The extreme corner of the letter “N” looks exactly like the letter “M” when it is extremely magnified.

19.3.1.1.1 Cooperation with Screen Reader

Some people with a moderate vision impairment may only have that visual acuity for part of the day. So, they may use a screen magnifier part of the day, or for certain tasks and then use a screen reader for less visually intensive tasks. Therefore, it is important that both assistive technologies can operate at the same time, such that the magnification shows the speaking location of the screen reader.

19.3.1.2 Relevant Specifications from Standards for ‘Screen Magnification’

Note that standards for “closed functionality” are included below to incorporate scenarios described by EN 301 549, 5.1.1 as “functionally closed”. In this case “functionally closed” is interpreted to mean a scenario that provides no user choice of AT (of the same type) and the application and platform are provided by the same supplier.

EN 301 549 Specification #	Specification	Comments
4.2.2 Usage with limited vision	Where ICT provides visual modes of operation, the ICT provides features that enable users to make better use of their limited vision. This is essential for users with limited vision and benefits many more users in different situations. NOTE 1: Magnification, reduction of required field of vision and control of contrast, brightness and intensity can contribute towards meeting this clause. NOTE 2: Where significant features of the user interface are	

		dependent on depth perception, the provision of additional methods of distinguishing between the features may contribute towards meeting this clause. NOTE 3: Users with limited vision may also benefit from non-visual access (see clause 4.2.1).	
4.2.3	Usage without perception of colour	Where ICT provides visual modes of operation, the ICT provides a visual mode of operation that does not require user perception of colour. This is essential for users with limited colour perception and benefits many more users in different situations. NOTE: Where significant features of the user interface are colour-coded, the provision of additional methods of distinguishing between the features may contribute towards meeting this clause.	
4.2.11	Privacy	Where ICT provides features for accessibility, the ICT maintains the privacy of users of these features at the same level as other users. NOTE: Enabling the connection of personal headsets for private listening, not providing a spoken version of characters being masked and enabling user control of legal, financial, and personal data are examples of design features that may contribute towards meeting this clause.	

5.1.3.1 Audio output of visual information	Where visual information is needed to enable the use of those functions of ICT that are closed to assistive technologies for screen reading, ICT shall provide at least one mode of operation using non-visual access to enable the use of those functions. NOTE 1: Non-visual access may be in an audio form, including speech, or a tactile form such as braille for deafblind users. NOTE 2: The visual information needed to enable use of some functions may include operating instructions and orientation, transaction prompts, user input verification, error messages and non-text content.	Generic Requirements section start
5.1.3.2 Auditory output delivery including speech	Where auditory output is provided as non-visual access to closed functionality, the auditory output shall be delivered: a) either directly by a mechanism included in or provided with the ICT; or b) by a personal headset that can be connected through a 3,5 mm audio jack, or an industry standard connection, without requiring the use of vision. NOTE 1: Mechanisms included in or provided with ICT may be, but are not limited to, a loudspeaker, a built-in handset/headset, or other industry standard coupled peripheral. NOTE 2: An industry standard	

		connection could be a wireless connection. NOTE 3: Some users may benefit from the provision of an inductive loop.	
5.1.3.4	Speech output user control	Where speech output is provided as non-visual access to closed functionality, the speech output shall be capable of being interrupted and repeated when requested by the user, where permitted by security requirements. NOTE 1: It is best practice to allow the user to pause speech output rather than just allowing them to interrupt it. NOTE 2: It is best practice to allow the user to repeat only the most recent portion rather than requiring play to start from the beginning.	
5.1.3.5	Speech output automatic interruption	Where speech output is provided as non-visual access to closed functionality, the ICT shall interrupt current speech output when a user action occurs and when new speech output begins. NOTE: Where it is essential that the user hears the entire message, e.g. a safety instruction or warning, the ICT may need to block all user action so that speech is not interrupted.	

5.1.3.6 Speech output for non-text content	Where ICT presents non-text content, the alternative for non-text content shall be presented to users via speech output unless the non-text content is pure decoration or is used only for visual formatting. The speech output for non-text content shall follow the guidance for "text alternative" described in WCAG 2.1 [5] Success Criterion 1.1.1.	
5.1.3.8 Masked entry	Where auditory output is provided as non-visual access to closed functionality, and the characters displayed are masking characters, the auditory output shall not be a spoken version of the characters entered unless the auditory output is known to be delivered only to a mechanism for private listening, or the user explicitly chooses to allow non-private auditory output. NOTE 1: Masking characters are usually displayed for security purposes and include, but are not limited to asterisks representing personal identification numbers. NOTE 2: Unmasked character output might be preferred when closed functionality is used, for example, in the privacy of the user's home. A warning highlighting privacy concerns might be appropriate to ensure that	

	the user has made an informed choice.	
5.1.3.9 Private access to personal data	Where auditory output is provided as non-visual access to closed functionality, and the output contains data that is considered to be private according to the applicable privacy policy, the corresponding auditory output shall only be delivered through a mechanism for private listening that can be connected without requiring the use of vision, or through any other mechanism explicitly chosen by the user. NOTE 1: This requirement does not apply in cases where data is not defined as being private according to the applicable privacy policy or where there is no applicable privacy policy. NOTE 2: Non-private output might be preferred when closed functionality is used, for example, in the privacy of the user's home. A warning highlighting privacy concerns might be appropriate to ensure that the user has made an informed choice	
5.1.3.10 Non-interfering audio output	Where auditory output is provided as non-visual access to closed functionality, the ICT shall not automatically play, at the same time, any interfering audible	

	output that lasts longer than three seconds.	
5.1.3.11 Private listening volume	Where auditory output is provided as non-visual access to closed functionality and is delivered through a mechanism for private listening, ICT shall provide at least one non-visual mode of operation for controlling the volume.	
5.1.3.12 Speaker volume	Where auditory output is provided as non-visual access to closed functionality and is delivered through speakers on ICT, a non-visual incremental volume control shall be provided with output amplification up to a level of at least 65 dBA (-29 dBPaA). NOTE: For noisy environments, 65 dBA may not be sufficient.	
5.1.3.13 Volume reset	Where auditory output is provided as non-visual access to closed functionality, a function that resets the volume to be at a level of 65 dBA or less after every use, shall be provided, unless the ICT is dedicated to a single user. NOTE: A feature to disable the volume reset function may be provided in order to enable the single-user exception to be met.	

5.1.3.14 Spoken languages	Where speech output is provided as non-visual access to closed functionality, speech output shall be in the same human language as the displayed content provided, except: a) for proper names, technical terms, words of indeterminate language, and words or phrases that have become part of the vernacular of the immediately surrounding text; b) where the content is generated externally and not under the control of the ICT vendor, the present clause shall not be required to apply for languages not supported by the ICT's speech synthesizer; c) for displayed languages that cannot be selected using non-visual access; d) where the user explicitly selects a speech language that is different from the language of the displayed content.	
5.1.3.15 Non-visual error identification	Where speech output is provided as non-visual access to closed functionality and an input error is automatically detected, speech output shall identify and describe the item that is in error.	
5.1.6.1 Operation without keyboard interface (closed functionality)	Where ICT functionality is closed to keyboards or keyboard interfaces, all functionality shall be operable without vision as required by clause 5.1.3.	

5.1.6.2 Operation without keyboard interface (Input focus)	Where ICT functionality is closed to keyboards or keyboard interfaces and where input focus can be moved to a user interface element, it shall be possible to move the input focus away from that element using the same mechanism, in order to avoid trapping the input focus.	
5.2 Activation of accessibility features	Where ICT has documented accessibility features, it shall be possible to activate those documented accessibility features that are required to meet a specific need without relying on a method that does not support that need.	
5.4 Preservation of accessibility information during conversion	Where ICT converts information or communication it shall preserve all documented non-proprietary information that is provided for accessibility, to the extent that such information can be contained in or supported by the destination format.	
5.5.2 Operable part discernibility	Where ICT has operable parts, it shall provide a means to discern each operable part, without requiring vision and without performing the action associated with the operable part. NOTE: One way of meeting this requirement is by making the operable parts tactilely discernible.	

5.6.1 Tactile or auditory status	Where ICT has a locking or toggle control and the status of that control is visually presented to the user, the ICT shall provide at least one mode of operation where the status of the control can be determined either through touch or sound without operating the control. NOTE 1: Locking or toggle controls are those controls that can only have two or three states and that keep their state while being used. NOTE 2: An example of a locking or toggle control is the "Caps Lock" key found on most keyboards. Another example is the volume button on a pay telephone, which can be set at normal, loud, or extra loud volume.	
7.2.1 Audio description playback	Where ICT displays video with synchronized audio, it shall provide a mechanism to select and play available audio description to the default audio channel. Where video technologies do not have explicit and separate mechanisms for audio description, an ICT is deemed to satisfy this requirement if the ICT enables the user to select and play several audio tracks. NOTE 1: In such cases, the video content can include the audio description as one of the available audio tracks. NOTE 2: Audio descriptions in digital media sometimes include	ICT with video capabilities section start

	information to allow descriptions that are longer than the gaps between dialogue. Support in digital media players for this "extended audio description" feature is useful, especially for digital media that is viewed personally.	
7.2.2 Audio description synchronization	Where ICT has a mechanism to play audio description, it shall preserve the synchronization between the audio/visual content and the corresponding audio description.	
7.2.3 Preservation of audio description	Where ICT transmits, converts, or records video with synchronized audio, it shall preserve audio description data such that it can be played in a manner consistent with clauses 7.2.1 and 7.2.2.	
7.3 User controls for captions and audio description	Where ICT primarily displays materials containing video with associated audio content, user controls to activate subtitling and audio description shall be provided to the user at the same level of interaction (i.e. the number of steps to complete the task) as the primary media controls. NOTE 1: Primary media controls are the set of controls that the user most commonly uses to control media. NOTE 2: Products that have a general hardware volume control,	

	such as a telephone, or a laptop which can be configured to display video through software but which is not its primary purpose, would not need dedicated hardware controls for captions and descriptions; however software controls, or hardware controls mapped through software, would need to be at the same level of interaction. NOTE 3: It is best practice for ICT to include additional controls enabling the user to select whether captions and audio descriptions are turned on or off by default.	
8.1.2 Standard connections	Where an ICT provides user input or output device connection points, the ICT shall provide at least one input and/or output connection that conforms to an industry standard non-proprietary format, directly or through the use of commercially available adapters. NOTE 1: The intent of this requirement is to ensure compatibility with assistive technologies by requiring the use of standard connections on ICT. NOTE 2: The word connection applies to both physical and wireless connections. NOTE 3: Current examples of industry standard non-proprietary formats are USB and Bluetooth.	Hardware Section Start

8.4.1 Numeric keys	Where provided, physical numeric keys arranged in a rectangular keypad layout shall have the number five key tactilely distinct from the other keys of the keypad. NOTE: Recommendation ITU-T E.161 [i.20] describes the 12-key telephone keypad layout and provides further details of the form of tactile markers.	This is a limited case in most phones today except for feature phones and a handful of phones with physical keypads.
11.1.1.1.1 Non-text content (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy WCAG 2.1 Success Criterion 1.1.1 Non-text Content. NOTE: CAPTCHAs do not currently appear outside of the Web. However, if they do appear, this guidance is accurate.	Software section start
11.1.1.1.2 Non-text content (closed functionality)	1Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.6 (Speech output for non-text content).	
11.1.2.1.1 Audio-only and video-only (pre-	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading	

recorded - open functionality)	and where pre-recorded auditory information is not needed to enable the use of closed functions of ICT, it shall satisfy the WCAG 2.1 Success Criterion 1.2.1 Audio-only and Video-only (Prerecorded). NOTE: The alternative can be provided directly in the software - or provided in an alternate version that meets the success criterion.	
11.1.2.1.2.2 Pre-recorded video-only (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.7 (Speech output for video information).	
11.1.2.3.1 Audio description or media alternative (pre-recorded - open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.2.3 Audio Description or Media Alternative (Prerecorded). NOTE 1: The WCAG 2.1 definition of "audio description" says that "audio description" is "also called 'video description' and 'descriptive narration'". NOTE 2: Secondary or alternate audio tracks are commonly used for this purpose.	

11.1.2.3.2 Audio description or media alternative (pre-recorded - closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.7 (Speech output for video information).	
11.1.2.5 Audio description (pre-recorded)	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.2.5 Audio Description (Prerecorded). NOTE 1: The WCAG 2.1 definition of "audio description" says that audio description is "Also called 'video description' and 'descriptive narration'". NOTE 2: Secondary or alternate audio tracks are commonly used for this purpose.	
11.1.3.1.1 Info and relationships (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.3.1 Info and Relationships. NOTE: In software, programmatic determinability is best achieved through the use of accessibility services provided by platform software to enable interoperability between software and assistive technologies and accessibility features of software.	

	(see clause 11.5 Interoperability with assistive technology).	
11.1.3.1.2 Info and relationships (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading and where information is displayed on the screen, the ICT should provide auditory information that allows the user to correlate the audio with the information displayed on the screen. NOTE 1: Many people who are legally blind still have visual ability, and use aspects of the visual display even if it cannot be fully comprehended. An audio alternative that is both complete and complementary includes all visual information such as focus or highlighting, so that the audio can be correlated with information that is visible on the screen at any point in time. NOTE 2: Examples of auditory information that allows the user to correlate the audio with the information displayed on the screen include structure and relationships conveyed through presentation.	
11.1.3.2.1 Meaningful sequence (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it	

	shall satisfy the WCAG 2.1 Success Criterion 1.3.2 Meaningful Sequence.	
11.1.3.3 Sensory characteristics	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.3.3 Sensory Characteristics.	
11.1.4.1 Use of colour	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.4.1 Use of Color.	Color vision loss
11.1.4.2 Audio control	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criterion: If any audio in a software plays automatically for more than 3 seconds, either a mechanism is available to pause or stop the audio, or a mechanism is available to control audio volume independently from the overall system volume level. NOTE 1: Since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software, all content in the software (whether or not it is used to meet other success criteria) shall meet this success criterion. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.2 Audio	

	Control replacing "on a Web page" with "in a software", "any content" with "any part of a software", "whole page" with "whole software", "on the Web page" with "in the software", removing "See Conformance Requirement 5: Non-Interference" and adding note 1.	
11.2.1.1.1 Keyboard (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to keyboards or a keyboard interface, it shall satisfy the WCAG 2.1 Success Criterion 2.1.1 Keyboard. NOTE: This does not imply that software is required to directly support a keyboard or "keyboard interface". Nor does it imply that software is required to provide a soft keyboard. Underlying platform software may provide device independent input services to applications that enable operation via a keyboard. Software that supports operation via such platform device independent services would be operable by a keyboard and would comply.	
11.2.1.1.2 Keyboard (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to keyboards or keyboard interface, it	

		shall meet requirement 5.1.6.1 (Operation without keyboard interface: Closed functionality).	
11.2.1.2	No keyboard trap	Where ICT is non-web software that provides a user interface, it shall satisfy the success criterion in Table 11.3.	
11.2.2.1	Timing adjustable	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For each time limit that is set by the software, at least one of the following is true: • Turn off: The user is allowed to turn off the time limit before encountering it; or • Adjust: The user is allowed to adjust the time limit before encountering it over a wide range that is at least ten times the length of the default setting; or • Extend: The user is warned before time expires and given at least 20 seconds to extend the time limit with a simple action (for example, "press the spacebar"), and the user is allowed to extend the time limit at least ten times; or • Real-time Exception: The time limit is a required part of a real-time event (for example, an auction), and no alternative to the time limit is possible; or	

	• Essential Exception: The time limit is essential and extending it would invalidate the activity; or • 20 Hour Exception: The time limit is longer than 20 hours. NOTE 1: This success criterion helps ensure that users can complete tasks without unexpected changes in content or context that are a result of a time limit. This success criterion should be considered in conjunction with WCAG 2.1 Success Criterion 3.2.1, which puts limits on changes of content or context as a result of user action. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 2.2.1 Timing Adjustable replacing "the content" with "software" and with the words "WCAG 2.1" added before the word "Success Criterion" in note 1 above.	
11.2.2.2 Pause, stop, hide	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For moving, blinking, scrolling, or auto-updating information, all of the following are true: • Moving, blinking, scrolling: For any moving, blinking or scrolling information that (1) starts automatically, (2) lasts more than five seconds, and (3) is presented in parallel	

	with other content, there is a mechanism for the user to pause, stop, or hide it unless the movement, blinking, or scrolling is part of an activity where it is essential; and • Auto-updating: For any auto-updating information that (1) starts automatically and (2) is presented in parallel with other content, there is a mechanism for the user to pause, stop, or hide it or to control the frequency of the update unless the auto-updating is part of an activity where it is essential. NOTE 1: For requirements related to flickering or flashing content, refer to WCAG 2.1 Guideline 2.3. NOTE 2: This success criteria is applicable to all content in the software (whether or not there is an alternate accessible mode of operation of the software) since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software (including a user interface element that enables the user to activate the alternate accessible mode of operation). NOTE 3: Content that is updated periodically by software or that is streamed to the user agent is not required to preserve or present information	
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	that is generated or received between the initiation of the pause and resuming presentation, as this may not be technically possible, and in many situations could be misleading to do so. NOTE 4: An animation that occurs as part of a preload phase or similar situation can be considered essential if interaction cannot occur during that phase for all users and if not indicating progress could confuse users or cause them to think that content was frozen or broken. NOTE 5: This is to be applied to all content. Any content, whether informative or decorative, that is updated automatically, blinks, or moves may create an accessibility barrier. NOTE 6: This success criterion is identical to the WCAG 2.1 Success Criterion 2.2.2 Pause, Stop, Hide replacing "page" and "Web page" with "software", removing "See Conformance Requirement 5: Non-Interference" in note 2 of the success criterion, with the words "WCAG 2.1" added before the word "Guideline" in note 1 above, with note 2 above re-drafted to avoid the use of the word "must" and with the addition of note 5 above.	
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11.2.4.3	Focus order	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: If software can be navigated sequentially and the navigation sequences affect meaning or operation, focusable components receive focus in an order that preserves meaning and operability. NOTE: This success criterion is identical to the WCAG 2.1 Success Criterion 2.4.3 Focus order replacing "Web page" with "software".	
11.2.4.4	Link purpose (in context)	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 2.4.4 Link Purpose (In Context).	
11.2.4.6	Headings and labels	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 2.4.6 Headings and Labels. NOTE: In software, headings and labels are used to describe sections of content and controls respectively. In some cases it may be unclear whether a piece of static text is a heading or a label. But whether treated as a label or a heading, the requirement is the same: that if they are present they describe the topic or purpose	

	of the item(s) they are associated with.	
11.2.4.7 Focus visible	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 2.4.7 Focus Visible.	
11.2.5.4 Motion actuation	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 2.5.4 Motion Actuation.	
11.3.1.1.1 Language of software (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the following success criteria: The default human language of software can be programmatically determined. NOTE 1: Where software platforms provide a "locale / language" setting, applications that use that setting and render their interface in that "locale / language" would comply with this success criterion. Applications that do not use the platform "locale / language" setting but instead use an accessibility-supported method for exposing the human language of the software would also comply with this success criterion. Applications implemented in technologies where assistive	

	technologies cannot determine the human language and that do not support the platform "locale / language" setting may not be able to meet this success criterion in that locale / language. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 3.1.1 Language of page, replacing "each web page" with "software" and with the addition of note 1 above.	
11.3.1.1.2 Language of software (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.14 (Spoken languages).	
11.3.2.1 On focus	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.2.1 On Focus. NOTE: Some compound documents and their user agents are designed to provide significantly different viewing and editing functionality depending upon what portion of the compound document is being interacted with (e.g. a presentation that contains an embedded spreadsheet, where the menus and toolbars of the user agent change depending upon whether the user is interacting with the presentation	

	content, or the embedded spreadsheet content). If the user uses a mechanism other than putting focus on that portion of the compound document with which they mean to interact (e.g. by a menu choice or special keyboard gesture), any resulting change of context would not be subject to this success criterion because it was not caused by a change of focus.	
11.3.2.2 On input	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.2.2 On Input.	
11.3.3.1.1 Error identification (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 3.3.1 Error Identification.	
11.3.3.1.2 Error Identification (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.15 (Non-visual error identification).	
11.3.3.2 Labels or instructions	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1	

	Success Criterion 3.3.2 Labels or Instructions.	
11.3.3.3 Error suggestion	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.3.3 Error Suggestion.	
11.3.3.4 Error prevention (legal, financial, data)	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For software that cause legal commitments or financial transactions for the user to occur, that modify or delete user controllable data in data storage systems, or that submit user test responses, at least one of the following is true: 1) Reversible: Submissions are reversible. 2) Checked: Data entered by the user is checked for input errors and the user is provided an opportunity to correct them. 3) Confirmed: A mechanism is available for reviewing, confirming, and correcting information before finalizing the submission. NOTE: This success criterion is identical to the WCAG 2.1 Success Criterion 3.3.4 Error Prevention (Legal, Financial, Data) replacing "web pages" with "software".	

11.4.1.1.1 Parsing (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to any assistive technologies, it shall satisfy the success criteria: For software that uses markup languages, in such a way that the markup is separately exposed and available to assistive technologies and accessibility features of software or to a user-selectable user agent, elements have complete start and end tags, elements are nested according to their specifications, elements do not contain duplicate attributes, and any IDs are unique, except where the specifications allow these features. NOTE 1: Start and end tags that are missing a critical character in their formation, such as a closing angle bracket or a mismatched attribute value quotation mark are not complete. NOTE 2: Markup is not always available to assistive technology or to user selectable user agents such as browsers. In such cases, conformance to this [requirement] would have no impact on accessibility as it can for web content where it is exposed. NOTE 3: Examples of markup that is separately exposed and available to assistive technologies and to user	
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	agents include but are not limited to: documents encoded in HTML, ODF, and OOXML. In these examples, the markup can be parsed entirely in two ways: (a) by assistive technologies which may directly open the document, (b) by assistive technologies using DOM APIs of user agents for these document formats. NOTE 4: Examples of markup used internally for persistence of the software user interface that are never exposed to assistive technology include but are not limited to: XUL, and FXML. In these examples assistive technology only interacts with the user interface of generated software. NOTE 5: This success criterion is identical to the WCAG 2.1 Success Criterion 4.1.1 Parsing replacing "In content implemented using markup languages" with "For software that uses markup languages, in such a way that the markup is separately exposed and available to assistive technologies and accessibility features of software or to a user-selectable user agent" with the addition of notes 2, 3 and 4 above	
11.4.1.2.1 Name, role, value (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to any	

	assistive technologies, it shall satisfy the following success criteria: For all user interface components (including but not limited to: form elements, links and components generated by scripts), the name and role can be programmatically determined; states, properties, and values that can be set by the user can be programmatically set; and notification of changes to these items is available to user agents, including assistive technologies. NOTE 1: This success criterion is primarily for software developers who develop or use custom user interface components. Standard user interface components on most accessibility-supported platforms already meet this success criterion when used according to specification. NOTE 2: For conforming to this success criterion, it is usually best practice for software user interfaces to use the accessibility services provided by platform software. These accessibility services enable interoperability between software user interfaces and both assistive technologies and accessibility features of software in standardised ways. Most platform accessibility services go beyond programmatic exposure of name	
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	and role, and programmatic setting of states, properties and values (and notification of same), and specify additional information that could or should be exposed and / or set (for instance, a list of the available actions for a given user interface component, and a means to programmatically execute one of the listed actions). NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 4.1.2 Name, Role, Value replacing the original WCAG 2.1 note with: "This success criterion is primarily for software developers who develop or use custom user interface components. Standard user interface components on most accessibility supported platforms already meet this success criterion when used according to specification." and the addition of note 2 above.	
11.4.1.3.1 Status messages (open functionality)	Where ICT is non-web software, it shall satisfy WCAG 2.1 Success Criterion 4.1.3 Status Messages.	
11.5.2.1 Platform accessibility service support for software that provides a user interface	Platform software shall provide a set of documented platform services that enable software that provides a user interface running on the platform software to interoperate with assistive	

	technology. Where a user interface concept corresponding to one of the clauses 11.5.2.5 to 11.5.2.17 is supported within the software environment, the platform software should support that requirement. For example, selection attributes from clause 11.5.2.14 (Modification of focus and selection attributes) may not exist in environments that do not allow selection, which is most commonly associated with copy and paste. NOTE 1: These define the minimum functionality of software providing user interfaces when using platform services. NOTE 2: In some platforms these services may be called accessibility services, but in some other platforms these services may be provided as part of the user interface services. NOTE 3: User interface services that provide accessibility support by default are considered to be part of the services provided to conform to this clause (e.g. the service for creating a new user interface element provides role, state, boundary, name and description). NOTE 4: To comply with this requirement the platform software can provide its own set of services	
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	or expose the services provided by its underlying platform layers, if those services conform to this requirement. NOTE 5: Within specific programming environments, the technical attributes associated with the user interface properties described in clauses 11.5.2.5 to 11.5.2.17 might have different names than those used within the clauses.	
11.5.2.2 Platform accessibility service support for assistive technologies	Platform software shall provide a set of documented platform accessibility services that enable assistive technology to interoperate with software that provides a user interface running on the platform software. Where a user interface concept corresponding to one of the clauses 11.5.2.5 to 11.5.2.17 is supported within the software environment, the platform software should support that requirement. For example, selection attributes from clause 11.5.2.14 (Modification of focus and selection attributes) may not exist in environments that do not allow selection, which is most commonly associated with copy and paste. NOTE 1: These define the minimum functionality available to assistive technologies when	

	using platform services. NOTE 2: The definition of platform in clause 3.1 applies to software that provides services to other software, including but not limited to, operating systems, web browsers, virtual machines. NOTE 3: In some platforms these services may be called accessibility services, but in some other platforms these services may be provided as part of the user interface services. NOTE 4: Typically these services belong to the same set of services that are described in clause 11.5.2.1. NOTE 5: To comply with this requirement the platform software can provide its own set of services or expose the services provided by its underlying platform layers, if those services conform to this requirement.	
11.5.2.3 Use of accessibility services	Where the software provides a user interface it shall use the applicable documented platform accessibility services. If the documented platform accessibility services do not allow the software to meet the applicable requirements of clauses 11.5.2.5 to 11.5.2.17, then software that provides a user interface shall use other documented services to interoperate with assistive technology.	

	NOTE: The term "documented platform accessibility services" refers to the set of services provided by the platform according to clauses 11.5.2.1 and 11.5.2.2. It is best practice to develop software using toolkits that automatically implement the underlying platform accessibility services.	
11.5.2.4 Assistive technology	Where the ICT is assistive technology, it shall use the documented platform accessibility services. NOTE 1: The term "documented platform accessibility services" refers to the set of services provided by the platform according to clauses 11.5.2.1 and 11.5.2.2. NOTE 2: Assistive technology can also use other documented accessibility services.	
11.5.2.5 Object information	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the user interface elements' role, state(s), boundary, name, and description programmatically determinable by assistive technologies.	
11.5.2.6 Row, column, and headers	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the row and column of each cell in a data table,	

	including headers of the row and column if present, programmatically determinable by assistive technologies.	
11.5.2.7 Values	Where the software provides a user interface, it shall, by using the services as described in clause 11.5.2.3, make the current value of a user interface element and any minimum or maximum values of the range, if the user interface element conveys information about a range of values, programmatically determinable by assistive technologies.	
11.5.2.8 Label relationships	Where the software provides a user interface it shall expose the relationship that a user interface element has as a label for another element, or of being labelled by another element, using the services as described in clause 11.5.2.3, so that this information is programmatically determinable by assistive technologies.	
11.5.2.9 Parent-child relationships	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the relationship between a user interface element and any parent or children elements programmatically determinable by assistive technologies.	

11.5.2.10 Text	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the text contents, text attributes, and the boundary of text rendered to the screen programmatically determinable by assistive technologies.	
11.5.2.11 List of available actions	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make a list of available actions that can be executed on a user interface element, programmatically determinable by assistive technologies.	
11.5.2.12 Execution of available actions	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow the programmatic execution of the actions exposed according to clause 11.5.2.11 by assistive technologies. NOTE 1: In some cases, the security requirements imposed on a software product may forbid external software from interfering with the ICT product. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and	

	control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.13 Tracking of focus and selection attributes	Where software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make information and mechanisms necessary to track focus, text insertion point, and selection attributes of user interface elements programmatically determinable by assistive technologies.	
11.5.2.14 Modification of focus and selection attributes	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow assistive technologies to programmatically modify focus, text insertion point, and selection attributes of user interface elements where the user can modify these items. NOTE 1: In some cases the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related	

	to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.15 Change notification	Where software provides a user interface it shall, by using the services as described in clause 11.5.2.3, notify assistive technologies about changes in those programmatically determinable attributes of user interface elements that are referenced in requirements 11.5.2.5 to 11.5.2.11 and 11.5.2.13.	
11.5.2.16 Modifications of states and properties	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow assistive technologies to programmatically modify states and properties of user interface elements, where the user can modify these items. NOTE 1: In some cases, the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities	

	related to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.17 Modifications of values and text	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow assistive technologies to modify values and text of user interface elements using the input methods of the platform, where a user can modify these items without the use of assistive technology. NOTE 1: In some cases the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	

11.6.1	User control of accessibility features	Where software is a platform, it shall provide sufficient modes of operation for user control over those platform accessibility features documented as intended for users.	
11.6.2	No disruption of accessibility features	Where software provides a user interface it shall not disrupt those documented accessibility features that are defined in platform documentation except when requested to do so by the user during the operation of the software.	
11.8.1	Content technology	Authoring tools shall conform to clauses 11.8.2 to 11.8.5 to the extent that information required for accessibility is supported by the format used for the output of the authoring tool.	
11.8.2	Accessible content creation	Authoring tools shall enable and guide the production of content that conforms to clauses 9 (Web content) or 10 (Non-Web content) as applicable. NOTE: Authoring tools may rely on additional tools where conformance with specific requirements is not achievable by a single tool. For example, a video editing tool may enable the creation of video files for distribution via broadcast television and the web, but	

	authoring of caption files for multiple formats may be provided by a different tool.	
11.8.3 Preservation of accessibility information in transformations	If the authoring tool provides restructuring transformations or re-coding transformations, then accessibility information shall be preserved in the output if equivalent mechanisms exist in the content technology of the output. NOTE 1: Restructuring transformations are transformations in which the content technology stays the same, but the structural features of the content are changed (e.g. linearizing tables, splitting a document into pages). NOTE 2: Re-coding transformations are transformations in which the technology used to encode the content is changed.	
11.8.4 Repair assistance	If the accessibility checking functionality of an authoring tool can detect that content does not meet a requirement of clauses 9 (Web) or 10 (Non-web documents) as applicable, then the authoring tool shall provide repair suggestion(s). NOTE: This does not preclude automated and semi-automated repair which is possible (and encouraged) for	

	many types of content accessibility problems.	
11.8.5 Templates	When an authoring tool provides templates, at least one template that supports the creation of content that conforms to the requirements of clauses 9 (Web) or 10 (Non-web documents) as applicable shall be available and identified as such.	
12.1.1 Accessibility and compatibility features	Product documentation provided with the ICT whether provided separately or integrated within the ICT shall list and explain how to use the accessibility and compatibility features of the ICT. NOTE 1: Accessibility and compatibility features include accessibility features that are built-in and accessibility features that provide compatibility with assistive technology. NOTE 2: It is best practice to use WebSchemas/Accessibility 2.0 [i.38] to provide metadata on the accessibility of the ICT. NOTE 3: The accessibility statement and help pages are both examples of the provision of product information	Documentation and Support Services start
12.1.2 Accessible documentation	Product documentation provided with the ICT shall be made available in at least one of the following electronic formats:	

	a) a Web format that conforms to the requirements of clause 9; or b) a non-web format that conforms to the requirements of clause 10. NOTE 1: This does not preclude the possibility of also providing the product documentation in other formats (electronic, printed or audio) that are not accessible. NOTE 2: It also does not preclude the possibility of providing alternate formats that meet the needs of some specific type of users (e.g. Braille documents for blind people or easy-to-read information for persons with limited cognitive, language and learning abilities). NOTE 3: Where documentation is incorporated into the ICT, the documentation falls under the requirements for accessibility in the present document. NOTE 4: A user agent that supports automatic media conversion would be beneficial to enhancing accessibility.	
12.2.2 Information on accessibility and compatibility features	ICT support services shall provide information on the accessibility and compatibility features that are mentioned in the product documentation. NOTE: Accessibility and compatibility features include accessibility features that are built-	

	in and accessibility features that provide compatibility with assistive technology.	
12.2.4 Accessible documentation	Documentation provided by support services shall be made available in at least one of the following electronic formats: a) a Web format that conforms to clause 9; or b) a non-web format that conforms to clause 10. NOTE 1: This does not preclude the possibility of also providing the documentation in other formats (electronic or printed) that are not accessible. NOTE 2: It also does not preclude the possibility of providing alternate formats that meet the needs of some specific type of users (e.g. Braille documents for blind people or easy-to-read information for persons with limited cognitive, language and learning abilities). NOTE 3: Where the support documentation is incorporated into the ICT, the documentation falls under the requirements for accessibility in the present document. NOTE 4: A user agent that supports automatic media conversion would be beneficial to enhancing accessibility.	

8.5 Tactile indication of speech mode	Where ICT is designed for shared use and speech output is available, a tactile indication of the means to initiate the speech mode of operation shall be provided. NOTE: The tactile indication could include Braille instructions.	
11.1.4.2 Audio control	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: If any audio in a software plays automatically for more than 3 seconds, either a mechanism is available to pause or stop the audio, or a mechanism is available to control audio volume independently from the overall system volume level. NOTE 1: Since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software, all content in the software (whether or not it is used to meet other success criteria) shall meet this success criterion. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.2 Audio Control replacing "on a Web page" with "in a software", "any content" with "any part of a software", "whole page" with "whole software", "on the Web page" with "in the software", removing	

	"See Conformance Requirement 5: Non-Interference" and adding note 1.	
5.1.3.3 Auditory output correlation	Where auditory output is provided as non-visual access to closed functionality, and where information is displayed on the screen, the ICT should provide auditory information that allows the user to correlate the audio with the information displayed on the screen. NOTE 1: Many people who are legally blind still have visual ability, and use aspects of the visual display even if it cannot be fully comprehended. An audio alternative that is both complete and complementary includes all visual information such as focus or highlighting, so that the audio can be correlated with information that is visible on the screen at any point in time. NOTE 2: Examples of auditory information that allows the user to correlate the audio with the information displayed on the screen include structure and relationships conveyed through presentation.	Closed functionality
5.1.4 Functionality closed to text enlargement	Where any functionality of ICT is closed to the text enlargement features of platform or assistive technology, the ICT shall provide a mode of operation where the text and images of text necessary for all functionality is displayed in such a way that a non-accented	

	capital "H" subtends an angle of at least 0,7 degrees at a viewing distance specified by the supplier.	
7.1.4 Captions characteristics	Where ICT displays captions, it shall provide a way for the user to adapt the displayed characteristics of captions to their individual requirements, except where the captions are displayed as unmodifiable characters. NOTE 1: Defining the background and foreground colour of subtitles, font type, size opacity of the background box of subtitles, and the contour or border of the fonts can contribute to meeting this requirement. NOTE 2: Subtitles that are bitmap images are examples of unmodifiable characters.	
8.1.3 Colour	Where the ICT has hardware aspects that use colour, colour shall not be used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element.	
11.1.3.5.1 Identify input purpose (open functionality)	Where ICT is non-web software that provides a user interface and supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.3.5 Identify Input Purpose.	Software

11.1.3.5.2 Identify input purpose (closed functionality)	Where ICT is non-web software that provides a user interface and is closed to assistive technologies, in at least one mode of operation the ICT shall present to the user, in an audio form, the purpose of each input field collecting information about the user when the input field serves a purpose identified in the WCAG 2.1 Input Purposes for User Interface Components section.	
11.1.4.3 Contrast (minimum)	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.4.3 Contrast (Minimum).	
11.1.4.4.1 Resize text (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to enlargement features of platform or assistive technology, it shall satisfy the WCAG 2.1 Success Criterion 1.4.4 Resize Text. NOTE 1: Content for which there are software players, viewers or editors with a 200 percent zoom feature would automatically meet this success criterion when used with such players, unless the content will not work with zoom. NOTE 2: This success criterion is about the ability to allow users to enlarge the text on screen at least up to 200 % without needing to use assistive technologies. This means that the application provides some means for enlarging the text 200 %	

	(zoom or otherwise) without loss of content or functionality or that the application works with the platform features that meet this requirement.	
11.1.4.4.2 Resize text (closed functionality)	Where ICT is non-web software that provides a user interface which is not able to access the enlargement features of platform or assistive technology, it shall meet requirement 5.1.4 (Functionality closed to text enlargement). NOTE: Because the text rendering support in a closed environment may be more limited than the support found in user agents for the Web, meeting the present clause in a closed environment may place a much heavier burden on the content author.	
11.1.4.5.1 Images of text (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.4.5 Images of Text.	
11.1.4.10 Reflow	Where ICT is non-web software that provides a user interface it shall satisfy the following success criteria: Content can be presented without loss of information or functionality, and without requiring scrolling in two dimensions for:	

	• Vertical scrolling content at a width equivalent to 320 CSS pixels; • Horizontal scrolling content at a height equivalent to 256 CSS pixels; Except for parts of the content which require a two-dimensional layout for usage or meaning. NOTE 1: 320 CSS pixels is equivalent to a starting viewport width of 1 280 CSS pixels wide at 400 % zoom. For non-web software which are designed to scroll horizontally (e.g. with vertical text), the 256 CSS pixels is equivalent to a starting viewport height of 1 024 px at 400 % zoom. NOTE 2: Examples of content which require two-dimensional layout are images, maps, diagrams, video, games, presentations, data tables, and interfaces where it is necessary to keep toolbars in view while manipulating content. NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.10 Reflow replacing the original WCAG 2.1 notes with notes 1 and 2, above.	
11.1.4.11 Non-text contrast	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 1.4.11 Non-text Contrast.	

11.1.4.12 Text spacing	Where ICT is non-web software that provides a user interface and that does not have a fixed size content layout area that is essential to the information being conveyed, it shall satisfy WCAG 2.1 Success Criterion 1.4.12 Text spacing.	
11.1.4.13 Content on hover or focus	Where ICT is a non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 1.4.13 Content on hover or focus.	
11.2.5.2 Pointer cancellation	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For functionality that can be operated using a single pointer, at least one of the following is true: • No Down-Event: The down-event of the pointer is not used to execute any part of the function. • Abort or Undo: Completion of the function is on the up-event, and a mechanism is available to abort the function before completion or to undo the function after completion. • Up Reversal: The up-event reverses any outcome of the preceding down-event. • Essential: Completing the function on the down-event is essential. NOTE 1: Functions that emulate a keyboard or numeric keypad key press are considered essential.	

		NOTE 2: This requirement applies to non-web software that interprets pointer actions (i.e. this does not apply to actions that are required to operate the user agent or assistive technology). NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 2.5.2 Pointer Cancellation replacing the original WCAG 2.1 note with notes 1 and 2 above.	
11.7	User preferences	Where software is not designed to be isolated from its platform, and provides a user interface, that user interface shall follow the values of the user preferences for platform settings for: units of measurement, colour, contrast, font type, font size, and focus cursor except where they are overridden by the user. NOTE 1: Software that is isolated from its underlying platform has no access to user settings in the platform and thus cannot adhere to them. NOTE 2: For web content, the underlying platform is the user agent. NOTE 3: This does not preclude the software from having additional values for a setting as long as there is one mode where the application will follow the system settings even if more restricted.	
11.2.3.1	Three flashes or below threshold	Where ICT is non-web software that provides a user interface, it shall satisfy the following success	

	criteria: Software does not contain anything that flashes more than three times in any one second period, or the flash is below the general flash and red flash thresholds. NOTE 1: This success criteria is applicable to all content in the software (whether or not there is an alternate accessible mode of operation of the software) since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software (including a user interface element that enables the user to activate the alternate accessible mode of operation). NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 2.3.1 Three Flashes or Below Threshold replacing "Web pages" with "software", "the whole page" with "the whole software", "the Web page" with "the software" and removing "See Conformance Requirement 5: Non-Interference" and with note 1 above re-drafted to avoid the use of the word "must".	
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20 Severe Vision Loss Persona



20.1 Performance Metrics

Table 15. Performance metrics for a severe vision loss persona.

Performance Metrics	Value
Visual Acuity	● No visual acuity – loss of all vision
Field of View Vertical	● No vertical field of view – loss of all vision
Field of View Horizontal	● No horizontal field of view – loss of all vision
	● No visual acuity – loss of all vision
Color Vision	● None
Photophobia	● No
Hearing	● Has average hearing

Range of Mobility	● Full function of the hands, wrists, and arms
Braille Usage	● Reads and writes in Braille proficiently

20.2 Use Case

Blindness

Lauren (16) has had total vision loss since she was a child, but she is an active teenager with a busy social life. She contracted Measles when she was young, and the blindness is a result.⁶¹ Like any teenager her social life revolves around her digital online presence. She regularly sends and receives SMS and instant messages and keeps up with her family on Facebook and plans after school activities through SnapChat.

Lauren learned Braille as other children learned to read. She grew up around a lot of technology. There has never been a time when she has not used technology in her everyday life. She uses a braille notetaker in school and to interact with her computer and mobile device. She uses text to speech when reading on the go and for entertainment. And is pleased that her smartphone recently enabled her to “type” Braille instead of the slower “hunt and peck” on the touch keyboard. This allows her to keep up with her friends who also have technology embedded in their lives. To go to activities, she takes public transport (using an accessible app) or rides with her parents or friends.

Lauren has discovered many mobile apps that help her independence in her daily life. For example, she has an app to help her:

- Identify colors,
- Read preparation instructions on packaging,
- Identify paper currency that is all the same size,
- Read bar codes to distinguish same-size canned goods,
- And even take photos.

20.3 Best Practices for Severe Vision Loss

20.3.1 Screen Readers with Audio or Tactile Output

⁶¹ [Childhood Blindness - an overview | ScienceDirect Topics](#)

Screen reader software is a digital text-to-speech converter. Users can hear written content using a keyboard to navigate. This is a particularly useful feature for users who are blind or have low vision, providing them with an independent and private way of accessing IT. People with some cognitive or learning disabilities and users who prefer audio over text can also reap the benefits of a screen reader. Screen readers are not only compatible with web-content, but also with documents, spreadsheets, and an operating system interface.⁶²

20.3.1.1 Technical Discussion for ‘Screen Readers’

When using a screen reader, one can expect the following characteristics:

- Ability to support your language of choice
- Ability to select from at least more than one male and female voices
- Ability to adjust the rate of speech up to at least 250 words per minute^{63 64 65}
- Ability to read content a word at a time, a sentence at a time, a paragraph at a time or the content of a complete page of content
- Ability to navigate web-based content by links and headings
- Support for a Braille display

Experienced users of screen readers typically can perceive and understand the output of a screen reader spoken at a rate faster than normal conversational speech. The speaking rate of an auctioneer is about 250 words per minute.⁶⁶ This speaking rate is considered fast for most people, but an experienced screen reader user can accommodate these faster speeds and, in some cases, even faster word per minute rate.

For navigating web-based content users typically have a number of different strategies. Since content from a web page is perceived in a linear format, one element of content at a time and in order, by a screen reader user

⁶² <https://webaim.org/techniques/screenreader/>

⁶³ [Average Words Per Minute Speaking \(15 Experts Examples\) \(improvepodcast.com\)](#)

⁶⁴ [Speech Rate: Do you speak too fast, too slow, or just right? \(write-out-loud.com\)](#)

⁶⁵ ” Speech calculator: how long does it take to deliver your speech?”. [Speech calculator: how long does your speech take? – Debatrix International](#)

⁶⁶ **Error! Hyperlink reference not valid.**

some users prefer to read all the content on a page first to determine what is there and then go back to the section they are interested in to read it in more detail. Other screen reader users prefer to read a list of the headings and links on a web page first to determine the nature of the content on that web page and then go directly to the section that has the content they are interested in. As a result, being able to read a list of heading and links and being able to navigate to the next heading and link or go directly to a heading or link is a preferred method of navigation for web content.

Additional preferred characteristics are:

- There should be ability to select a voice with the appropriate accent (for Canada – Québécois French and English)
- It may also support the following commands to control the screen reader or actions associated with the screen reader

20.3.1.1.1 Accommodating Differences between Screen Readers

Although all screen readers have similar functionality and capabilities, there are variations between them, such as in shortcuts, voices, and the manner of vocalizing links. These variations often have little effect on coding methods because users will be used to the norms of their favored screen reader. The most important thing is to adhere to commonly recognized accessibility standards and best practices.⁶⁷

20.3.1.1.2 Linear Content

Audio interfaces have linear content organization, where users are presented with information bits one at a time. In contrast, most sighted users interact with visual interfaces by scanning the whole screen at once, absorbing the content's overarching structure, aesthetic, and other macro elements. This cannot be done with a screen reader, so the fact that audio interfaces linearize web content is an important guiding point for any web-developers design process.⁶⁸

⁶⁷ <https://webaim.org/techniques/screenreader/>

⁶⁸ <https://webaim.org/techniques/screenreader/>

20.3.1.1.3 Navigating Content

Although audio interfaces are linear in nature, users can navigate the content faster when using a screen reader through the use of a couple features.

20.3.1.1.4 Links and Form Controls

One way to navigate content more quickly using a screen reader is by using the Tab key to go between different links provided on the interface. This can be useful when looking for a specific link. Another method like the use of the Tab key is to have an alphabetically arranged list of provided links. However, using these methods can result in the user missing other content that may be important to them. For more information, see <http://webaim.org/techniques/hypertext/>.

Implication: Any provided link should be read out in a way that makes sense without its context.

20.3.1.1.5 Headings

Jumping from heading to heading is an additional strategy for getting a general sense of the content of a page. Users can listen to an overview of the page's key concepts before going back to the sections of interest. This method's biggest flaw is that it depends on headings, which far too many pages don't have. See more information at <http://webaim.org/>.

Implication: Web developers and authors should use headings to give a text or a website structure. The titles should, to the greatest degree possible, accurately summarize the content.

20.3.1.1.6 Landmarks and page sections

Users can make use of ARIA landmarks and HTML5 section elements like <nav>, <header>, <main> to navigate the contents of an audio interface.

Implication: Web developers and authors should use ARIA landmarks and HTML5 section elements appropriately.

20.3.1.1.7 Paragraphs and page elements

Users can skip through from one paragraph to the next by listening to the opening sentence of each section, similarly to how users interact with visual interfaces by scanning the page and then choosing a pertinent area. A similar way of interacting with an audio interface is to jump from element to element (<div> tags, form elements, itemized lists, links, and other content units).

Implication: The defining information of a paragraph should, whenever possible, be included in the opening sentence.

20.3.1.1.8 Others

Screen reader users use tables, buttons, forms, images, lists, links, etc. to navigate any audio interface content.

Implication: Use HTML semantic structure properly, with appropriately marked elements.

20.3.1.2 Mobile screen readers

Most screen readers do not connect external keyboards to their mobile devices despite the existing possibility. Instead, they navigate in two distinct ways:

- Touch navigation – dragging a finger across the screen and having the information directly under the finger read out.
- Swipe navigation – swiping right and left to move between items, similar to what the Tab key would do on an external keyboard.

20.3.2 Relevant Specifications from Standards for ‘Screen Readers’

Note that standards for “closed functionality” are included below to incorporate scenarios described by EN 301 549, 5.1.1 as “functionally closed”. In this case “functionally closed” is interpreted to mean a scenario that provides no user choice of AT (of the same type) and the application and platform are provided by the same supplier.

EN 301 549 Specification #	Specification	Comments
4.2.1 Usage without vision	Where ICT provides visual modes of operation, the ICT provides at least one mode of operation that does not require vision. This is essential for users without vision and benefits many more users in different situations. NOTE 1: A web page or application with a well-formed semantic structure can allow users without vision to identify, navigate and interact with a visual user interface. NOTE 2: Audio and tactile user interfaces may contribute towards meeting this clause	Functional Performance Section start
4.2.11 Privacy	Where ICT provides features for accessibility, the ICT maintains the privacy of users of these features at the same level as other users. NOTE: Enabling the connection of personal headsets for private listening, not providing a spoken version of characters being masked and enabling user control of legal, financial, and personal data are examples of design features that may contribute towards meeting this clause.	

5.1.3.1 Audio output of visual information	Where visual information is needed to enable the use of those functions of ICT that are closed to assistive technologies for screen reading, ICT shall provide at least one mode of operation using non-visual access to enable the use of those functions. NOTE 1: Non-visual access may be in an audio form, including speech, or a tactile form such as braille for deafblind users. NOTE 2: The visual information needed to enable use of some functions may include operating instructions and orientation, transaction prompts, user input verification, error messages and non-text content.	Generic Requirements section start
5.1.3.2 Auditory output delivery including speech	Where auditory output is provided as non-visual access to closed functionality, the auditory output shall be delivered: a) either directly by a mechanism included in or provided with the ICT; or b) by a personal headset that can be connected through a 3,5 mm audio jack, or an industry standard connection, without requiring the use of	

	vision. NOTE 1: Mechanisms included in or provided with ICT may be, but are not limited to, a loudspeaker, a built-in handset/headset, or other industry standard coupled peripheral. NOTE 2: An industry standard connection could be a wireless connection. NOTE 3: Some users may benefit from the provision of an inductive loop.	
5.1.3.4 Speech output user control	Where speech output is provided as non-visual access to closed functionality, the speech output shall be capable of being interrupted and repeated when requested by the user, where permitted by security requirements. NOTE 1: It is best practice to allow the user to pause speech output rather than just allowing them to interrupt it. NOTE 2: It is best practice to allow the user to repeat only the most recent portion rather than requiring play to start from the beginning.	
5.1.3.5 Speech output automatic interruption	Where speech output is provided as non-visual access to closed functionality, the ICT shall interrupt current speech	

	output when a user action occurs and when new speech output begins. NOTE: Where it is essential that the user hears the entire message, e.g. a safety instruction or warning, the ICT may need to block all user action so that speech is not interrupted.	
5.1.3.6 Speech output for non-text content	Where ICT presents non-text content, the alternative for non-text content shall be presented to users via speech output unless the non-text content is pure decoration or is used only for visual formatting. The speech output for non-text content shall follow the guidance for "text alternative" described in WCAG 2.1 [5] Success Criterion 1.1.1.	
5.1.3.8 Masked entry	Where auditory output is provided as non-visual access to closed functionality, and the characters displayed are masking characters, the auditory output shall not be a spoken version of the characters entered unless the auditory output is known to be delivered only to a mechanism for private	

	listening, or the user explicitly chooses to allow non-private auditory output. NOTE 1: Masking characters are usually displayed for security purposes and include, but are not limited to asterisks representing personal identification numbers. NOTE 2: Unmasked character output might be preferred when closed functionality is used, for example, in the privacy of the user's home. A warning highlighting privacy concerns might be appropriate to ensure that the user has made an informed choice.	
5.1.3.9 Private access to personal data	Where auditory output is provided as non-visual access to closed functionality, and the output contains data that is considered to be private according to the applicable privacy policy, the corresponding auditory output shall only be delivered through a mechanism for private listening that can be connected without requiring the use of vision, or through any other	

		mechanism explicitly chosen by the user. NOTE 1: This requirement does not apply in cases where data is not defined as being private according to the applicable privacy policy or where there is no applicable privacy policy. NOTE 2: Non-private output might be preferred when closed functionality is used, for example, in the privacy of the user's home. A warning highlighting privacy concerns might be appropriate to ensure that the user has made an informed choice	
5.1.3.10	Non-interfering audio output	Where auditory output is provided as non-visual access to closed functionality, the ICT shall not automatically play, at the same time, any interfering audible output that lasts longer than three seconds.	
5.1.3.11	Private listening volume	Where auditory output is provided as non-visual access to closed functionality and is delivered through a mechanism for private listening, ICT shall provide at least one non-visual mode of operation for controlling the volume.	

5.1.3.12 Speaker volume	Where auditory output is provided as non-visual access to closed functionality and is delivered through speakers on ICT, a non-visual incremental volume control shall be provided with output amplification up to a level of at least 65 dBA (-29 dBPaA). NOTE: For noisy environments, 65 dBA may not be sufficient.	
5.1.3.13 Volume reset	Where auditory output is provided as non-visual access to closed functionality, a function that resets the volume to be at a level of 65 dBA or less after every use, shall be provided, unless the ICT is dedicated to a single user. NOTE: A feature to disable the volume reset function may be provided in order to enable the single-user exception to be met.	
5.1.3.14 Spoken languages	Where speech output is provided as non-visual access to closed functionality, speech output shall be in the same human language as the displayed content provided, except: a) for proper names, technical terms, words of indeterminate language, and	

		words or phrases that have become part of the vernacular of the immediately surrounding text; b) where the content is generated externally and not under the control of the ICT vendor, the present clause shall not be required to apply for languages not supported by the ICT's speech synthesizer; c) for displayed languages that cannot be selected using non-visual access; d) where the user explicitly selects a speech language that is different from the language of the displayed content.	
5.1.3.15	Non-visual error identification	Where speech output is provided as non-visual access to closed functionality and an input error is automatically detected, speech output shall identify and describe the item that is in error.	
5.1.6.1	Operation without keyboard interface (closed functionality)	Where ICT functionality is closed to keyboards or keyboard interfaces, all functionality shall be operable without vision as required by clause 5.1.3.	
5.1.6.2	Operation without keyboard interface (Input focus)	Where ICT functionality is closed to keyboards or keyboard interfaces and where input focus can be	

	moved to a user interface element, it shall be possible to move the input focus away from that element using the same mechanism, in order to avoid trapping the input focus.	
5.2 Activation of accessibility features	Where ICT has documented accessibility features, it shall be possible to activate those documented accessibility features that are required to meet a specific need without relying on a method that does not support that need.	
5.4 Preservation of accessibility information during conversion	Where ICT converts information or communication it shall preserve all documented non-proprietary information that is provided for accessibility, to the extent that such information can be contained in or supported by the destination format.	
5.5.2 Operable part discernibility	Where ICT has operable parts, it shall provide a means to discern each operable part, without requiring vision and without performing the action associated with the operable part. NOTE: One way of meeting this requirement is by making the operable parts tactilely discernible.	

5.6.1 Tactile or auditory status	Where ICT has a locking or toggle control and the status of that control is visually presented to the user, the ICT shall provide at least one mode of operation where the status of the control can be determined either through touch or sound without operating the control. NOTE 1: Locking or toggle controls are those controls that can only have two or three states and that keep their state while being used. NOTE 2: An example of a locking or toggle control is the "Caps Lock" key found on most keyboards. Another example is the volume button on a pay telephone, which can be set at normal, loud, or extra loud volume.	
7.2.1 Audio description playback	Where ICT displays video with synchronized audio, it shall provide a mechanism to select and play available audio description to the default audio channel. Where video technologies do not have explicit and separate mechanisms for audio description, an ICT is deemed to satisfy this requirement if the ICT enables the user to select and play several audio tracks.	ICT with video capabilities section start This section not specific to screen reader but necessary to complete task on primary task list

	NOTE 1: In such cases, the video content can include the audio description as one of the available audio tracks. NOTE 2: Audio descriptions in digital media sometimes include information to allow descriptions that are longer than the gaps between dialogue. Support in digital media players for this "extended audio description" feature is useful, especially for digital media that is viewed personally.	
7.2.2 Audio description synchronization	Where ICT has a mechanism to play audio description, it shall preserve the synchronization between the audio/visual content and the corresponding audio description.	
7.2.3 Preservation of audio description	Where ICT transmits, converts, or records video with synchronized audio, it shall preserve audio description data such that it can be played in a manner consistent with clauses 7.2.1 and 7.2.2.	
7.3 User controls for captions and audio description	Where ICT primarily displays materials containing video with associated audio content, user controls to activate subtitling and audio description shall be provided	

	to the user at the same level of interaction (i.e. the number of steps to complete the task) as the primary media controls. NOTE 1: Primary media controls are the set of controls that the user most commonly uses to control media. NOTE 2: Products that have a general hardware volume control, such as a telephone, or a laptop which can be configured to display video through software but which is not its primary purpose, would not need dedicated hardware controls for captions and descriptions; however software controls, or hardware controls mapped through software, would need to be at the same level of interaction. NOTE 3: It is best practice for ICT to include additional controls enabling the user to select whether captions and audio description are turned on or off by default.	
8.1.2 Standard connections	Where an ICT provides user input or output device connection points, the ICT shall provide at least one input and/or output connection that conforms to an industry standard non-proprietary format, directly or through	Hardware Section Start

	the use of commercially available adapters. NOTE 1: The intent of this requirement is to ensure compatibility with assistive technologies by requiring the use of standard connections on ICT. NOTE 2: The word connection applies to both physical and wireless connections. NOTE 3: Current examples of industry standard non-proprietary formats are USB and Bluetooth.	
8.4.1 Numeric keys	Where provided, physical numeric keys arranged in a rectangular keypad layout shall have the number five key tactilely distinct from the other keys of the keypad. NOTE: Recommendation ITU-T E.161 [i.20] describes the 12-key telephone keypad layout and provides further details of the form of tactile markers.	This is a limited case in most phones today except for feature phones and a handful of phones with physical keypads.
11.1.1.1.1 Non-text content (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy WCAG 2.1 Success Criterion	Software section start

	1.1.1 Non-text Content. NOTE: CAPTCHAs do not currently appear outside of the Web. However, if they do appear, this guidance is accurate.	
11.1.1.1.2 Non-text content (closed functionality)	1Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.6 (Speech output for non-text content).	
11.1.2.1.1 Audio-only and video-only (pre-recorded - open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading and where pre-recorded auditory information is not needed to enable the use of closed functions of ICT, it shall satisfy the WCAG 2.1 Success Criterion 1.2.1 Audio-only and Video-only (Pre-recorded). NOTE: The alternative can be provided directly in the software - or provided in an alternate version that meets the success criterion.	
11.1.2.1.2.2 Pre-recorded video-	Where ICT is non-web software that provides a user interface which is closed to	

only (closed functionality)	assistive technologies for screen reading, it shall meet requirement 5.1.3.7 (Speech output for video information).	
11.1.2.3.1 Audio description or media alternative (pre-recorded - open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.2.3 Audio Description or Media Alternative (Pre-recorded). NOTE 1: The WCAG 2.1 definition of "audio description" says that "audio description" is "also called 'video description' and 'descriptive narration'". NOTE 2: Secondary or alternate audio tracks are commonly used for this purpose.	
11.1.2.3.2 Audio description or media alternative (pre-recorded - closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.7 (Speech output for video information).	

11.1.2.5 Audio description (pre-recorded)	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.2.5 Audio Description (Pre-recorded). NOTE 1: The WCAG 2.1 definition of "audio description" says that audio description is "Also called 'video description' and 'descriptive narration'". NOTE 2: Secondary or alternate audio tracks are commonly used for this purpose.	
11.1.3.1.1 Info and relationships (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.3.1 Info and Relationships. NOTE: In software, programmatic determinability is best achieved through the use of accessibility services provided by platform software to enable interoperability between software and assistive technologies and accessibility features of software. (See clause 11.5	

	Interoperability with assistive technology).	
11.1.3.1.2 Info and relationships (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading and where information is displayed on the screen, the ICT should provide auditory information that allows the user to correlate the audio with the information displayed on the screen. NOTE 1: Many people who are legally blind still have visual ability, and use aspects of the visual display even if it cannot be fully comprehended. An audio alternative that is both complete and complementary includes all visual information such as focus or highlighting, so that the audio can be correlated with information that is visible on the screen at any point in time. NOTE 2: Examples of auditory information that allows the user to correlate the audio with the information displayed on the screen include structure and relationships conveyed through presentation.	

11.1.3.2.1 Meaningful sequence (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.3.2 Meaningful Sequence.	
11.1.3.3 Sensory characteristics	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 1.3.3 Sensory Characteristics.	
11.1.4.2 Audio control	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criterion: If any audio in a software plays automatically for more than 3 seconds, either a mechanism is available to pause or stop the audio, or a mechanism is available to control audio volume independently from the overall system volume level. NOTE 1: Since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software, all content in the software (whether or not it is used to	

	meet other success criteria) shall meet this success criterion. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.2 Audio Control replacing "on a Web page" with "in a software", "any content" with "any part of a software", "whole page" with "whole software", "on the Web page" with "in the software", removing "See Conformance Requirement 5: Non-Interference" and adding note 1.	
11.2.1.1.1 Keyboard (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to keyboards or a keyboard interface, it shall satisfy the WCAG 2.1 Success Criterion 2.1.1 Keyboard. NOTE: This does not imply that software is required to directly support a keyboard or "keyboard interface". Nor does it imply that software is required to provide a soft keyboard. Underlying platform software may provide device independent input services to applications that enable operation via a keyboard. Software that supports operation via	

	such platform device independent services would be operable by a keyboard and would comply.	
11.2.1.1.2 Keyboard (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to keyboards or keyboard interface, it shall meet requirement 5.1.6.1 (Operation without keyboard interface: Closed functionality).	
11.2.1.2 No keyboard trap	Where ICT is non-web software that provides a user interface, it shall satisfy the success criterion in Table 11.3.	
11.2.2.1 Timing adjustable	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For each time limit that is set by the software, at least one of the following is true: • Turn off: The user is allowed to turn off the time limit before encountering it; or • Adjust: The user is allowed to adjust the time limit before encountering it over a wide range that is at least ten times the length of the default setting; or • Extend: The user is warned before time expires and given	

	at least 20 seconds to extend the time limit with a simple action (for example, "press the spacebar"), and the user is allowed to extend the time limit at least ten times; or • Real-time Exception: The time limit is a required part of a real-time event (for example, an auction), and no alternative to the time limit is possible; or • Essential Exception: The time limit is essential and extending it would invalidate the activity; or • 20 Hour Exception: The time limit is longer than 20 hours. NOTE 1: This success criterion helps ensure that users can complete tasks without unexpected changes in content or context that are a result of a time limit. This success criterion should be considered in conjunction with WCAG 2.1 Success Criterion 3.2.1, which puts limits on changes of content or context as a result of user action. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 2.2.1 Timing Adjustable replacing "the content" with	
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		"software" and with the words "WCAG 2.1" added before the word "Success Criterion" in note 1 above.	
11.2.2.2	Pause, stop, hide	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For moving, blinking, scrolling, or auto-updating information, all of the following are true: • Moving, blinking, scrolling: For any moving, blinking or scrolling information that (1) starts automatically, (2) lasts more than five seconds, and (3) is presented in parallel with other content, there is a mechanism for the user to pause, stop, or hide it unless the movement, blinking, or scrolling is part of an activity where it is essential; and • Auto-updating: For any auto-updating information that (1) starts automatically and (2) is presented in parallel with other content, there is a mechanism for the user to pause, stop, or hide it or to control the frequency of the update unless the auto-updating is part of an activity where it is essential.	

	NOTE 1: For requirements related to flickering or flashing content, refer to WCAG 2.1 Guideline 2.3. NOTE 2: This success criteria is applicable to all content in the software (whether or not there is an alternate accessible mode of operation of the software) since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software (including a user interface element that enables the user to activate the alternate accessible mode of operation). NOTE 3: Content that is updated periodically by software or that is streamed to the user agent is not required to preserve or present information that is generated or received between the initiation of the pause and resuming presentation, as this may not be technically possible, and in many situations could be misleading to do so. NOTE 4: An animation that occurs as part of a preload phase or similar situation can be considered essential if interaction cannot occur	
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		during that phase for all users and if not indicating progress could confuse users or cause them to think that content was frozen or broken. NOTE 5: This is to be applied to all content. Any content, whether informative or decorative, that is updated automatically, blinks, or moves may create an accessibility barrier. NOTE 6: This success criterion is identical to the WCAG 2.1 Success Criterion 2.2.2 Pause, Stop, Hide replacing "page" and "Web page" with "software", removing "See Conformance Requirement 5: Non-Interference" in note 2 of the success criterion, with the words "WCAG 2.1" added before the word "Guideline" in note 1 above, with note 2 above re-drafted to avoid the use of the word "must" and with the addition of note 5 above.	
11.2.4.3	Focus order	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: If software can be navigated sequentially and the navigation sequences affect meaning or operation, focusable	

		components receive focus in an order that preserves meaning and operability. NOTE: This success criterion is identical to the WCAG 2.1 Success Criterion 2.4.3 Focus order replacing "Web page" with "software".	
11.2.4.4	Link (in purpose context)	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 2.4.4 Link Purpose (In Context).	
11.2.4.6	Headings and labels	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 2.4.6 Headings and Labels. NOTE: In software, headings and labels are used to describe sections of content and controls respectively. In some cases it may be unclear whether a piece of static text is a heading or a label. But whether treated as a label or a heading, the requirement is the same: that if they are present, they describe the topic or purpose of the item(s) they are associated with.	

11.2.4.7 Focus visible	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 2.4.7 Focus Visible.	
11.2.5.4 Motion actuation	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 2.5.4 Motion Actuation.	
11.3.1.1.1 Language of software (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the following success criteria: The default human language of software can be programmatically determined. NOTE 1: Where software platforms provide a "locale / language" setting, applications that use that setting and render their interface in that "locale / language" would comply with this success criterion. Applications that do not use the platform "locale / language" setting but instead use an accessibility-supported method for exposing the human language of the software would also	

	comply with this success criterion. Applications implemented in technologies where assistive technologies cannot determine the human language and that do not support the platform "locale / language" setting may not be able to meet this success criterion in that locale / language. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 3.1.1 Language of page, replacing "each web page" with "software" and with the addition of note 1 above.	
11.3.1.1.2 Language of software (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.14 (Spoken languages).	
11.3.2.1 On focus	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.2.1 On Focus. NOTE: Some compound documents and their user agents are designed to provide significantly different viewing	

	and editing functionality depending upon what portion of the compound document is being interacted with (e.g. a presentation that contains an embedded spreadsheet, where the menus and toolbars of the user agent change depending upon whether the user is interacting with the presentation content, or the embedded spreadsheet content). If the user uses a mechanism other than putting focus on that portion of the compound document with which they mean to interact (e.g. by a menu choice or special keyboard gesture), any resulting change of context would not be subject to this success criterion because it was not caused by a change of focus.	
11.3.2.2 On input	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.2.2 On Input.	
11.3.3.1.1 Error identification (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 3.3.1 Error Identification.	

11.3.3.1.2 Error Identification (closed functionality)	Where ICT is non-web software that provides a user interface which is closed to assistive technologies for screen reading, it shall meet requirement 5.1.3.15 (Non-visual error identification).	
11.3.3.2 Labels or instructions	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.3.2 Labels or Instructions.	
11.3.3.3 Error suggestion	Where ICT is non-web software that provides a user interface, it shall satisfy the WCAG 2.1 Success Criterion 3.3.3 Error Suggestion.	
11.3.3.4 Error prevention (legal, financial, data)	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For software that cause legal commitments or financial transactions for the user to occur, that modify or delete user controllable data in data storage systems, or that submit user test responses, at least one of the following is true: 1) Reversible: Submissions are reversible.	

	2) Checked: Data entered by the user is checked for input errors and the user is provided an opportunity to correct them. 3) Confirmed: A mechanism is available for reviewing, confirming, and correcting information before finalizing the submission. NOTE: This success criterion is identical to the WCAG 2.1 Success Criterion 3.3.4 Error Prevention (Legal, Financial, Data) replacing "web pages" with "software".	
11.4.1.1.1 Parsing (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to any assistive technologies, it shall satisfy the success criteria: For software that uses markup languages, in such a way that the markup is separately exposed and available to assistive technologies and accessibility features of software or to a user-selectable user agent, elements have complete start and end tags, elements are nested according to their specifications, elements do	

	not contain duplicate attributes, and any IDs are unique, except where the specifications allow these features. NOTE 1: Start and end tags that are missing a critical character in their formation, such as a closing angle bracket or a mismatched attribute value quotation mark are not complete. NOTE 2: Markup is not always available to assistive technology or to user selectable user agents such as browsers. In such cases, conformance to this [requirement] would have no impact on accessibility as it can for web content where it is exposed. NOTE 3: Examples of markup that is separately exposed and available to assistive technologies and to user agents include but are not limited to: documents encoded in HTML, ODF, and OOXML. In these examples, the markup can be parsed entirely in two ways: (a) by assistive technologies which may directly open the document, (b) by assistive technologies using DOM APIs of user agents for these document formats.	
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	NOTE 4: Examples of markup used internally for persistence of the software user interface that are never exposed to assistive technology include but are not limited to: XUL, and FXML. In these examples assistive technology only interacts with the user interface of generated software. NOTE 5: This success criterion is identical to the WCAG 2.1 Success Criterion 4.1.1 Parsing replacing "In content implemented using markup languages" with "For software that uses markup languages, in such a way that the markup is separately exposed and available to assistive technologies and accessibility features of software or to a user-selectable user agent" with the addition of notes 2, 3 and 4 above	
11.4.1.2.1 Name, role, value (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to any assistive technologies, it shall satisfy the following success criteria: For all user interface components (including but not limited to: form elements,	

	links and components generated by scripts), the name and role can be programmatically determined; states, properties, and values that can be set by the user can be programmatically set; and notification of changes to these items is available to user agents, including assistive technologies. NOTE 1: This success criterion is primarily for software developers who develop or use custom user interface components. Standard user interface components on most accessibility-supported platforms already meet this success criterion when used according to specification. NOTE 2: For conforming to this success criterion, it is usually best practice for software user interfaces to use the accessibility services provided by platform software. These accessibility services enable interoperability between software user interfaces and both assistive technologies and accessibility features of software	
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	in standardised ways. Most platform accessibility services go beyond programmatic exposure of name and role, and programmatic setting of states, properties and values (and notification of same), and specify additional information that could or should be exposed and / or set (for instance, a list of the available actions for a given user interface component, and a means to programmatically execute one of the listed actions). NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 4.1.2 Name, Role, Value replacing the original WCAG 2.1 note with: "This success criterion is primarily for software developers who develop or use custom user interface components. Standard user interface components on most accessibility supported platforms already meet this success criterion when used according to specification." and the addition of note 2 above.	
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11.4.1.3.1 Status messages (open functionality)	Where ICT is non-web software, it shall satisfy WCAG 2.1 Success Criterion 4.1.3 Status Messages.	
11.5.2.1 Platform accessibility service support for software that provides a user interface	Platform software shall provide a set of documented platform services that enable software that provides a user interface running on the platform software to interoperate with assistive technology. Where a user interface concept corresponding to one of the clauses 11.5.2.5 to 11.5.2.17 is supported within the software environment, the platform software should support that requirement. For example, selection attributes from clause 11.5.2.14 (Modification of focus and selection attributes) may not exist in environments that do not allow selection, which is most commonly associated with copy and paste. NOTE 1: These define the minimum functionality of software providing user interfaces when using platform services. NOTE 2: In some platforms these services may be called accessibility services, but in	

	some other platforms these services may be provided as part of the user interface services. NOTE 3: User interface services that provide accessibility support by default are considered to be part of the services provided to conform to this clause (e.g. the service for creating a new user interface element provides role, state, boundary, name and description). NOTE 4: To comply with this requirement the platform software can provide its own set of services or expose the services provided by its underlying platform layers, if those services conform to this requirement. NOTE 5: Within specific programming environments, the technical attributes associated with the user interface properties described in clauses 11.5.2.5 to 11.5.2.17 might have different names than those used within the clauses.	
11.5.2.2 Platform accessibility service support for	Platform software shall provide a set of documented platform accessibility services that enable assistive	

assistive technologies	technology to interoperate with software that provides a user interface running on the platform software. Where a user interface concept corresponding to one of the clauses 11.5.2.5 to 11.5.2.17 is supported within the software environment, the platform software should support that requirement. For example, selection attributes from clause 11.5.2.14 (Modification of focus and selection attributes) may not exist in environments that do not allow selection, which is most commonly associated with copy and paste. NOTE 1: These define the minimum functionality available to assistive technologies when using platform services. NOTE 2: The definition of platform in clause 3.1 applies to software that provides services to other software, including but not limited to, operating systems, web browsers, virtual machines. NOTE 3: In some platforms these services may be called accessibility services, but in some other platforms these services may be provided as part of the user interface services. NOTE 4: Typically these	
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	services belong to the same set of services that are described in clause 11.5.2.1. NOTE 5: To comply with this requirement the platform software can provide its own set of services or expose the services provided by its underlying platform layers, if those services conform to this requirement.	
11.5.2.3 Use of accessibility services	Where the software provides a user interface it shall use the applicable documented platform accessibility services. If the documented platform accessibility services do not allow the software to meet the applicable requirements of clauses 11.5.2.5 to 11.5.2.17, then software that provides a user interface shall use other documented services to interoperate with assistive technology. NOTE: The term "documented platform accessibility services" refers to the set of services provided by the platform according to clauses 11.5.2.1 and 11.5.2.2. It is best practice to develop software using toolkits that automatically implement the underlying platform accessibility services.	

11.5.2.4 Assistive technology	Where the ICT is assistive technology, it shall use the documented platform accessibility services. NOTE 1: The term "documented platform accessibility services" refers to the set of services provided by the platform according to clauses 11.5.2.1 and 11.5.2.2. NOTE 2: Assistive technology can also use other documented accessibility services.	
11.5.2.5 Object information	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the user interface elements' role, state(s), boundary, name, and description programmatically determinable by assistive technologies.	
11.5.2.6 Row, column, and headers	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the row and column of each cell in a data table, including headers of the row and column if present, programmatically determinable by assistive technologies.	

11.5.2.7 Values	Where the software provides a user interface, it shall, by using the services as described in clause 11.5.2.3, make the current value of a user interface element and any minimum or maximum values of the range, if the user interface element conveys information about a range of values, programmatically determinable by assistive technologies.	
11.5.2.8 Label relationships	Where the software provides a user interface it shall expose the relationship that a user interface element has as a label for another element, or of being labelled by another element, using the services as described in clause 11.5.2.3, so that this information is programmatically determinable by assistive technologies.	
11.5.2.9 Parent-child relationships	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the relationship between a user interface element and any parent or children elements programmatically	

	determinable by assistive technologies.	
11.5.2.10 Text	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make the text contents, text attributes, and the boundary of text rendered to the screen programmatically determinable by assistive technologies.	
11.5.2.11 List of available actions	Where the software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make a list of available actions that can be executed on a user interface element, programmatically determinable by assistive technologies.	
11.5.2.12 Execution of available actions	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow the programmatic execution of the actions exposed according to clause 11.5.2.11 by assistive technologies. NOTE 1: In some cases, the security requirements imposed on a software product may forbid external software from interfering	

	with the ICT product. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.13 Tracking of focus and selection attributes	Where software provides a user interface it shall, by using the services as described in clause 11.5.2.3, make information and mechanisms necessary to track focus, text insertion point, and selection attributes of user interface elements programmatically determinable by assistive technologies.	
11.5.2.14 Modification of focus and selection attributes	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow assistive technologies to programmatically modify focus, text insertion point, and selection attributes of user interface elements where the user can modify these	

	items. NOTE 1: In some cases the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.15 Change notification	Where software provides a user interface it shall, by using the services as described in clause 11.5.2.3, notify assistive technologies about changes in those programmatically determinable attributes of user interface elements that are referenced in requirements 11.5.2.5 to 11.5.2.11 and 11.5.2.13.	
11.5.2.16 Modifications of	Where permitted by security requirements, software that provides a user interface	

states and properties	shall, by using the services as described in clause 11.5.2.3, allow assistive technologies to programmatically modify states and properties of user interface elements, where the user can modify these items. NOTE 1: In some cases, the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.5.2.17 Modifications of values and text	Where permitted by security requirements, software that provides a user interface shall, by using the services as described in clause 11.5.2.3, allow assistive technologies to modify values and text of user interface elements using the input methods of the platform, where a user can	

		modify these items without the use of assistive technology. NOTE 1: In some cases the security requirements imposed on a software product may forbid external software from interfering with the ICT product and so this requirement would not apply. Examples of systems under strict security requirements are systems dealing with intelligence activities, cryptologic activities related to national security, command and control of military forces. NOTE 2: Assistive technologies may be required to maintain the same level of security as the standard input mechanisms supported by the platform.	
11.6.1 User control of accessibility features		Where software is a platform, it shall provide sufficient modes of operation for user control over those platform accessibility features documented as intended for users.	
11.6.2 No disruption of accessibility features	No of	Where software provides a user interface it shall not disrupt those documented accessibility features that are defined in platform documentation	

	except when requested to do so by the user during the operation of the software.	
11.8.1 Content technology	Authoring tools shall conform to clauses 11.8.2 to 11.8.5 to the extent that information required for accessibility is supported by the format used for the output of the authoring tool.	
11.8.2 Accessible content creation	Authoring tools shall enable and guide the production of content that conforms to clauses 9 (Web content) or 10 (Non-Web content) as applicable. NOTE: Authoring tools may rely on additional tools where conformance with specific requirements is not achievable by a single tool. For example, a video editing tool may enable the creation of video files for distribution via broadcast television and the web, but authoring of caption files for multiple formats may be provided by a different tool.	
11.8.3 Preservation of accessibility information in transformations	If the authoring tool provides restructuring transformations or re-coding transformations, then accessibility information shall be preserved in the output if equivalent mechanisms exist in the content technology of the	

	output. NOTE 1: Restructuring transformations are transformations in which the content technology stays the same, but the structural features of the content are changed (e.g. linearizing tables, splitting a document into pages). NOTE 2: Re-coding transformations are transformations in which the technology used to encode the content is changed.	
12.1.1 Accessibility and compatibility features	Product documentation provided with the ICT whether provided separately or integrated within the ICT shall list and explain how to use the accessibility and compatibility features of the ICT. NOTE 1: Accessibility and compatibility features include accessibility features that are built-in and accessibility features that provide compatibility with assistive technology. NOTE 2: It is best practice to use WebSchemas/Accessibility 2.0 [i.38] to provide metadata	Documentation and Support Services start

	on the accessibility of the ICT. NOTE 3: The accessibility statement and help pages are both examples of the provision of product information	
12.1.2 Accessible documentation	Product documentation provided with the ICT shall be made available in at least one of the following electronic formats: a) a Web format that conforms to the requirements of clause 9; or b) a non-web format that conforms to the requirements of clause 10. NOTE 1: This does not preclude the possibility of also providing the product documentation in other formats (electronic, printed or audio) that are not accessible. NOTE 2: It also does not preclude the possibility of providing alternate formats that meet the needs of some specific type of users (e.g. Braille documents for blind people or easy-to-read information for persons with limited cognitive, language and learning abilities). NOTE 3: Where documentation is	

	incorporated into the ICT, the documentation falls under the requirements for accessibility in the present document. NOTE 4: A user agent that supports automatic media conversion would be beneficial to enhancing accessibility.	
12.2.2 Information on accessibility and compatibility features	ICT support services shall provide information on the accessibility and compatibility features that are mentioned in the product documentation. NOTE: Accessibility and compatibility features include accessibility features that are built-in and accessibility features that provide compatibility with assistive technology.	
12.2.4 Accessible documentation	Documentation provided by support services shall be made available in at least one of the following electronic formats: a) a Web format that conforms to clause 9; or b) a non-web format that conforms to clause 10. NOTE 1: This does not preclude the possibility of also providing the documentation in other formats (electronic or	

		printed) that are not accessible. NOTE 2: It also does not preclude the possibility of providing alternate formats that meet the needs of some specific type of users (e.g. Braille documents for blind people or easy-to-read information for persons with limited cognitive, language and learning abilities). NOTE 3: Where the support documentation is incorporated into the ICT, the documentation falls under the requirements for accessibility in the present document. NOTE 4: A user agent that supports automatic media conversion would be beneficial to enhancing accessibility.	
8.5	Tactile indication of speech mode	Where ICT is designed for shared use and speech output is available, a tactile indication of the means to initiate the speech mode of operation shall be provided. NOTE: The tactile indication could include Braille instructions.	
11.1.4.2	Audio control	Where ICT is non-web software that provides a user interface, it shall satisfy the	

	following success criterions: If any audio in a software plays automatically for more than 3 seconds, either a mechanism is available to pause or stop the audio, or a mechanism is available to control audio volume independently from the overall system volume level. NOTE 1: Since any part of a software that does not meet this success criterion can interfere with a user's ability to use the whole software, all content in the software (whether or not it is used to meet other success criteria) shall meet this success criterion. NOTE 2: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.2 Audio Control replacing "on a Web page" with "in a software", "any content" with "any part of a software", "whole page" with "whole software", "on the Web page" with "in the software", removing "See Conformance Requirement 5: Non-Interference" and adding note 1.	
5.1.3.3 Auditory output correlation	Where auditory output is provided as non-visual access to closed functionality, and	Closed functionality

	where information is displayed on the screen, the ICT should provide auditory information that allows the user to correlate the audio with the information displayed on the screen. NOTE 1: Many people who are legally blind still have visual ability, and use aspects of the visual display even if it cannot be fully comprehended. An audio alternative that is both complete and complementary includes all visual information such as focus or highlighting, so that the audio can be correlated with information that is visible on the screen at any point in time. NOTE 2: Examples of auditory information that allows the user to correlate the audio with the information displayed on the screen include structure and relationships conveyed through presentation.	
11.1.3.5.1 Identify input purpose (open functionality)	Where ICT is non-web software that provides a user interface and supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success	Software

	Criterion 1.3.5 Identify Input Purpose.	
11.1.3.5.2 Identify input purpose (closed functionality)	Where ICT is non-web software that provides a user interface and is closed to assistive technologies, in at least one mode of operation the ICT shall present to the user, in an audio form, the purpose of each input field collecting information about the user when the input field serves a purpose identified in the WCAG 2.1 Input Purposes for User Interface Components section.	
11.1.4.5.1 Images of text (open functionality)	Where ICT is non-web software that provides a user interface and that supports access to assistive technologies for screen reading, it shall satisfy the WCAG 2.1 Success Criterion 1.4.5 Images of Text.	
11.1.4.10 Reflow	Where ICT is non-web software that provides a user interface it shall satisfy the following success criteria: Content can be presented without loss of information or functionality, and without requiring scrolling in two dimensions for:	

	• Vertical scrolling content at a width equivalent to 320 CSS pixels; • Horizontal scrolling content at a height equivalent to 256 CSS pixels; Except for parts of the content which require a two-dimensional layout for usage or meaning. NOTE 1: 320 CSS pixels is equivalent to a starting viewport width of 1 280 CSS pixels wide at 400 % zoom. For non-web software which are designed to scroll horizontally (e.g. with vertical text), the 256 CSS pixels is equivalent to a starting viewport height of 1024 px at 400 % zoom. NOTE 2: Examples of content which require two-dimensional layout are images, maps, diagrams, video, games, presentations, data tables, and interfaces where it is necessary to keep toolbars in view while manipulating content. NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 1.4.10 Reflow replacing the original WCAG 2.1 notes with notes 1 and 2, above.	
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11.1.4.13 Content on hover or focus	Where ICT is a non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 1.4.13 Content on hover or focus.	
11.2.5.2 Pointer cancellation	Where ICT is non-web software that provides a user interface, it shall satisfy the following success criteria: For functionality that can be operated using a single pointer, at least one of the following is true: • No Down-Event: The down-event of the pointer is not used to execute any part of the function. • Abort or Undo: Completion of the function is on the up-event, and a mechanism is available to abort the function before completion or to undo the function after completion. • Up Reversal: The up-event reverses any outcome of the preceding down-event. • Essential: Completing the function on the down-event is essential. NOTE 1: Functions that emulate a keyboard or numeric keypad key press are considered essential. NOTE 2: This requirement applies to non-web software	

		that interprets pointer actions (i.e. this does not apply to actions that are required to operate the user agent or assistive technology). NOTE 3: This success criterion is identical to the WCAG 2.1 Success Criterion 2.5.2 Pointer Cancellation replacing the original WCAG 2.1 note with notes 1 and 2 above.	
11.7	User preferences	Where software is not designed to be isolated from its platform, and provides a user interface, that user interface shall follow the values of the user preferences for platform settings for: units of measurement, colour, contrast, font type, font size, and focus cursor except where they are overridden by the user. NOTE 1: Software that is isolated from its underlying platform has no access to user settings in the platform and thus cannot adhere to them. NOTE 2: For web content, the underlying platform is the user agent. NOTE 3: This does not preclude the software from having additional values for a setting as long as there is one mode where the application will follow the system settings even if more restricted.	

21 Seizure-inducing Visual Stimulus Persona

21.1 Performance Metrics

Table 16. Performance Metrics for Seizure-Inducing Visual Stimulus Persona.

Criteria #	Criteria Description	Compliance Detail
1	Visual Acuity	● Normal
2	Field of View	● Normal
3	Contrast	● Normal
4	Hearing	● Normal
5	Range of Mobility	● full function of the hands, wrist, arms

This user can have normal or impaired vision, yet their perception of some moving or flashing stimuli can cause a seizure. If this happens at the wrong time or place, the vulnerable person experiencing a seizure can be severely, or even fatally injured.

21.2 Use case

Photosensitive epilepsy

Jim did not even know he had an issue until he woke up on the floor after a video game session. After waking up with a headache and subsequent extensive testing, he was told he has Photosensitive Epilepsy.⁶⁹ Now, he must limit his video game choices to minimize the possibility of flashing content. He also looks for standards-compliant software and web sites after learning that they also avoid the presentation of flashing content.

⁶⁹ [Photosensitive Epilepsy: Causes, Symptoms, and Treatment \(webmd.com\)](https://www.webmd.com/epilepsy/conditions-and-living/photosensitive-epilepsy)

21.3 Best Practices for Seizure-inducing Visual Stimulus Persona

21.3.1 Technical Discussion for ‘Outputs’

As specified in the personas above, this group of users requires that presented content does not flash. Or at least does not flash more than 3 times per second.

21.3.1.1 Relevant Specifications from Standards for ‘Outputs’

Technical standard reference	Conformance specification	Comments
EN 301 549 – 4.2.9 Minimize photosensitive seizure triggers	Where ICT provides visual modes of operation, some users need ICT to provide at least one mode of operation that minimizes the potential for triggering photosensitive seizures. NOTE: Limiting the area and number of flashes per second may contribute towards meeting this clause.	WCAG 2.1 Success Criterion 2.3.1 Three Flashes or Below Threshold is the authoritative source on meeting this requirement.
EN 301 549 – 9.2.3.1 Three flashes or below threshold	Where ICT is a web page, it shall satisfy WCAG 2.1 Success Criterion 2.3.1 Three Flashes or Below Threshold .	
EN 301 549 - 10.2.3.1 Three flashes or below threshold	Where ICT is a non-web document, it shall satisfy WCAG 2.1 Success Criterion 2.3.1 Three Flashes or Below Threshold .	

EN 301 549 - 11.2.3.1 Three flashes or below threshold	Where ICT is non-web software that provides a user interface, it shall satisfy WCAG 2.1 Success Criterion 2.3.1 Three Flashes or Below Threshold.	
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21.3.2 *Technical Discussion for ‘Inputs’*

No input limitation.

22 Procurement Process

The goal of this document is to provide a mechanism for procuring accessible mobile devices either for an individual, a group of individuals with a specific class of disabilities, or a mobile device that meets the needs of all users across all disability communities, to be used by a department, agency, or ministry that is part of the government. The section will explain how to use the various sections of this document within the procurement process of a department, agency, or ministry. Ultimately, any procurement process is intended to produce formal procurement text that can be inserted into a procurement document for potential vendors to review and bid on to provide a product or service. The process is made up of the following steps:

- Identify the end user and determine the needs of the individual or groups of individuals the department is buying the mobile device/devices for
- Confirm the goals of the end users
- Collate the performance metrics and best practice guidance for each of the classes of user the mobile devices are intended for
- Collate the accompanying technical requirements and specifications that define each best practices
- Enter the information on user personas, performance metrics, best practices and technical requirements and specifications into the procurement template for your department
- Acceptance of the Delivered Product
- Functional testing
- End user acceptance process

22.1 Identifying the Stakeholders

The procurement process may be purchasing an accessible mobile device for a specific individual, a group of individuals with the same specific needs, or all potential users within a disability community accounting for the various levels of severity or a mobile device that is intended to meet the needs of a cross section of people from all disability groups and with all levels of disabilities.

Even if purchasing for an individual, the procurement specifications may extend way beyond the accessibility needs of the individual and the mobile device itself. There may be specific needs associated with the infrastructure and policies of the office, department, ministry, or government agency the user works for. Security and privacy concerns, and the type of applications and services the department's information technology division uses and can support must also be taken into consideration. Similarly, the policies and needs of the office, department, ministry, or agency need to be taken into consideration. It may take time to train the user on a device he is not familiar with. The office or department may use applications that are not available on the mobile device with the recommended accessibility features. All these factors must be taken into consideration when putting together the text for the procurement document.

Make sure to identify all stakeholders related to the usage of the mobile device and make them part of the specification development, testing, and acceptance processes.

The document only deals with the specifications that are necessary to generate the text for the procurement and testing of a mobile device or devices that have the appropriate accessibility features. Procurement personnel will have to work with the other stakeholders to ensure their needs are met.

22.2 Confirming Goals of the End Users

A list of representative tasks is provided in Section 12. That list was intended to incorporate the majority of the individual actions that are required to interact with a mobile device. While the interaction may change over time, the activities the end-user wants to achieve will change at a slower pace. For

example, using a voice assistant to compose a text message is distinctly different from:

1. Finding the text message app icon
2. Selecting that icon and activating it
3. Find the contact phone number of the person you want to send a text message to in the contact list
4. Selecting and activating that contact name from the contact list
5. Enter the text of your message
6. Selecting and activating the “send” button or editing the text message again before sending it

Currently both methods are supported but one may fade from usage, or a third method may displace one of them. Correspondingly voice assistants do not work for people who cannot speak.

The list is not exhaustive. The individual, office, department, ministry, or agency may have specific applications (apps) or services it wants the end user to be able to interact with. It is important to include those apps as part of the task list. That task list will be used as a part of the testing and acceptance procedures. It is possible to procure a mobile device that is technically accessible but does not allow the user to fully interact with the specific apps. Correspondingly, it is possible to procure a mobile device that allows the user to interact with the specified apps that is not fully accessible to all the features of the phone. It is thus important to reflect all the stakeholder requirements in the procurement document.

22.3 Collate Performance Metrics and Best Practice for Each End Users

Once the end user or end users are identified the personas and best practices for each end user or end users will be the high-level guidance that will be provided in the procurement document. The best practices make up the best classes of solutions identified by the authors as currently implemented in mobile devices that exist today. The best practices are not necessarily associated with one specific brand or model of mobile device. The authors have tried to be agnostic and not be biased to one specific brand or model of device. In some cases, the best of class solutions may exist in different brands and models of mobile devices. The authors have chosen the best practices

based on the most effective and efficient solution for the end-users' ability level.

22.4 Collate Technical Requirement and Specifications

Associated with each best practice is a list of technical requirements and a list of prescriptive specifications pulled from existing accessibility standards regarding information and communications technology and which specifically apply or have been modified to apply to mobile devices. Most existing accessibility standards and guidelines refer to the broader class of information and communications technologies (ICT). ICT encompasses everything from automatic banking machines and fax machines to mobile devices and their respective apps. None of the standards and guidelines are specific to mobile devices. This document has drawn heavily from those guidelines and standards, and applied them specifically to mobile devices and apps, as they apply to the advanced communication functionality of mobile devices. The authors have, where possible, used the existing prescriptive standard or guideline specifications by referencing the appropriate standard, paragraph, and section. Where the standards and guidelines were insufficiently detailed, the authors have made additions to the specification. Where there were competing specifications or parts of specification that were in conflict or offered contradictions, the authors have tried to resolve the issues and make a definite recommendation with a rationale for the change.

Note that the specifications were drawn from accessibility standards around the world. The final specifications included in this document is a combination of mainly the European EN 301 549, Section 508 of the Rehabilitation Act of 1973 (USA), and W3C WCAG 2.1. While these standards should be familiar to most major mobile device manufacturers, they are often treated as a separate regional checklist to be complied with. As the specifications in this document include the most current and relevant specifications from each standard, it is important that potential suppliers not simply defer to one regional standard and assume all the specifications are the same. In Canada the proposed standard for ICT is the EN 301 549. See the checklist in Section 10.1 for additions, omissions, and modifications to EN 301 549 to accommodate mobile devices specifically. Each disability community will have a specific set of additions, omissions and modifications that need to be considered in the process.

22.5Generate Procurement Template

The actual format of the procurement document will depend on the policies and procedure of the particular office, department, agency, or ministry. The major sections have been described above. A sample template of a procurement document is shown in Appendix B. It is based on the American Section 508 procurement template which can be seen here:

<https://assets.section508.gov/files/ART%20Contract%20Language%20Template.pdf>

22.6Acceptance of the Delivered Product

There are three phases to the acceptance process:

- Declaration of Accessibility Compliance by suppliers/manufacturers
- Functional testing to confirm compliance by the purchaser
- End user acceptance process

The Declaration of Accessibility Compliance (DAC) by supplier/manufacturers is based on the American Voluntary Product Accessibility Template (VPAT) 2.0. The DAC is a report attesting to the accessibility of an information and communication technology (ICT) product or service. To maintain a level of compatibility with the long established VPAT, the DAC used many of the same sections, descriptions and definitions. The goal is to make the transition easier for suppliers and manufacturers to adopt this new format.

The DAC may potentially be adopted as the official document that should be required on all federal solicitations. The DAC combines elements from the standards and guidelines from the American Section 508, the European EN 301 549, the American CVAA, G3ICT and the W3C WAG (ISO/IEC 40500:2012). As detailed in the document the standard combines all the best practices from all the standards and guidelines.

In the DAC, the vendor is asked to provide some basic information:

- Name of Product/Version
- Product Description
- Date
- Contact Information
- Notes

- List of Best Practice Declarations
- Evaluation Methods Used determine compliance with the procurement document specifications
- Applicable Standards/Guidelines
- Terms
- Tables for Each Standard or Guideline

A key portion of this section is the “Notes” field. The DAC instructions provide guidance on this field, which includes:

- Additional information about the product version that the document references
- Any revisions to the document
- Links to any related documents
- Additional information describing the product
- Additional information about what the document does or does not cover
- Information suggested by the WCAG 2.0 Conformance Claim if applicable, at <http://www.w3.org/TR/WCAG20/#conformance-claims>
- Information needed to satisfy ISO/IEC 17050-1:2004, Supplier’s Declaration of Conformity

Note that the procurement language will have “best practices” for each disability community and level of disability. If the supplier product does not contain a solution that implements the recommended best practice for a specific disability community and level of disability, they can provide information on an equivalent solution that provides an equivalent level of access. Details on how to determine if a solution provides an equivalent level of access is covered in Section 12: “Test Process for New Accessibility Solutions” of the Accessible Procurement Mobile Device Standards document.

The next key addition is the field, “Evaluation Method Used.” The DAC provides the following suggestions as responses:

- Testing is based on general product knowledge
- Similar to another evaluated product
- Testing with assistive technologies
- Published test method (provide name, publisher, URL link)
- Vendor proprietary test method

- Other test method

This section is intended for the supplier to present a purchaser with the significant details of how accessible a product is. For example, when attesting to the accessibility of a product or service the supplier may have used automated accessibility testing. This type of testing may only catch a fraction of the accessibility errors for this product or service class. Therefore, any declaration that does not include manual and automated testing may require further examination by the purchaser. Suppliers are encouraged to provide as much detail as possible to ensure the product or service is not unnecessarily delayed in the evaluation and acceptance process.

The next key field is “Applicable Standards/Guidelines.” It explicitly asks the level of conformance reporting. This typically applies to WCAG 2.0 criteria. WCAG 2.0 asks the supplier to state which sections have been included. For most products, the purchaser will be looking for WCAG Level A or Level AA. Level AAA is a highly specialized category and is not required for most organizations at this time.

Table 17. Applicable Standards/Guidelines for DAC.

Standard/Guideline	Included In Report
Web Content Accessibility Guidelines 2.0, at www.w3.org/TR/2008/REC-WCAG20-20081211/	Level A (Yes/No) Level AA (Yes/No) Level AAA (Yes/No)
Section 508 as published in 2017, at www.Section508.gov	(Yes/No)
EN 301 549 Accessibility requirements suitable for public procurement of ICT products and services in Europe, at http://mandate376.standards.eu/standard	(Yes/No)

Within the “Criteria” column, both the older Section 508 standards and the EN 301 549 are mapped to the WCAG requirement. This is to reduce ambiguity for the vendor when mapping these older standards to WCAG. Within “Conformance Level,” ITI breaks down the components that could conceivably make up a product. It is the vendors responsibility to use one of the following conformance levels on all components that apply:

Note to Reviewer: We have received comments in regards to the terminology typically used in the traditional VPAT that “supports” is not strong enough. The authors have used the terminology “complies” to replace “supports”. The authors are open to discussion on which is the more appropriate terminology.

- **Complies:** The functionality of the product has at least one method that meets the criterion for each level of disability in the required disability communities without known defects or meets with equivalent facilitation.
- **Partially Complies:** Some functionality of the product does not meet the criterion.
- **Does Not Support:** The majority of product functionality does not meet the criterion.
- **Not Applicable:** The criterion is not relevant to the product.
- **Not Evaluated:** The product has not been evaluated against the criterion.

There are various forms of the VPAT supported by the Information Technology Industry Council (ITT). The various formats can be found here:

[VPAT - Information Technology Industry Council \(itac.org\)](http://itac.org)

VPAT 2.4 Rev 508: Revised Section 508 standards – the U.S. Federal accessibility standard ¹²⁶

VPAT 2.4 Rev EU: EN 301 549 – the European Union’s “Accessibility requirements suitable for public procurement of ICT products and services in Europe” ¹²⁷

VPAT 2.4 Rev WCAG: WCAG 2.1 or ISO/IEC 40500 (equivalent to WCAG 2.0) and WCAG2.1, W3C/WAI’s recently updated Web Content Accessibility Guidelines ¹²⁸

VPAT 2.4 INT: Incorporates all three of the above standards ¹²⁹

- The instructions for the final column, “Remarks and Explanations,” attempt to further tighten reporting with the following suggestions:
- When the conformance level is “Supports with Exceptions” or “Does Not Support,” the remarks should identify:
 - a. The functions or features with issues
 - b. How they do not fully support
- If the criterion does not apply, explain why.
- If an accessible alternative accommodation is available, describe it. This is key to responding to this section. A failure without a secondary

alternative (accommodation) may at the discretion of the purchaser disqualify the product from consideration.

The final area is “Legal Disclaimer.” While the area is vaguely described, we believe vendors will produce good faith language that states that an effort has been made to accurately and completely describe the accessibility of the product, but that there may be minor technical flaws that will not impede the use of the product or service by a person with vision, hearing or mobility challenges. These disclaimers usually contain a clearly stated commitment to ensuring equal access for all users and a summary of the overall level of compliance with accessible technology standards. Key to this section is a wide belief that 100% accessibility is not achievable as there are a myriad of technical failures that would not hinder the use of the product but would violate the WCAG 2.1.

Like the VPAT[®], the DAC is not a certification of compliance nor is it intended to be a pass/fail tool. The DAC is intended to provide an opportunity for the supplier or manufacturer to provide significant insight into the degree to which a product will be perceivable and usable by a person with vision, hearing, mobility, or cognitive challenges to the purchasing officer. Completing the form only attests to the degree to which it complies with the prescribed standards or guidelines. The purchaser must evaluate the responses in the DAC and determine if the product as stated meets the accessibility needs of the organization or individuals. It is not a replacement for the next step which is compliance testing by the organization procuring the product or service and a review process by the final end user/users and stakeholders. In the compliance declaration a supplier and/or manufacturer must provide information about the degree of compliance with a standard or guideline, the testing process they used to confirm it and a list for any exceptions regarding the accessibility of the product or service in very specific test conditions. For the later disclosure it will be up to the organization procuring the mobile device to ensure the exception will not materially affect the intended end user from completing the list of tasks they need to perform their job.

23 Declaration Of Accessibility Compliance (DAC) Form

Name of Product/ Version	
Product Description	
Report Creation Date	
Contact Information	

Applicable Standards and Guidelines Used in Report

Standards and Guidelines	Notes
EN 301 549 Accessibility requirements for ICT products and services - V3.2.1 (2021-03)	
Enhanced Mobility Device Framework Criteria (i.e... This document)	
Web Content Accessibility Guidelines 2.1	

23.1 Terms

The terms used in the Conformance Level information are defined as follows:

- Complies: The functionality of the product has at least one method that meets the criterion without known defects or meets with equivalent facilitation.
- Partially Complies: Some functionality of the product does not meet the criterion.
- Does Not Support: The majority of product functionality does not meet the criterion.
- Not Applicable: The criterion is not relevant to the product.
- Not Evaluated: The product has not been evaluated against the criterion.

23.2 Primary Task List provided by Procurement Agency

Note: This is a sampling only of tasks. Each procuring agency will have a task list that potentially extends beyond this primary list.

1	Reading the instructions on how to use the device that comes with the device packaging or is available from an online source
2	Setting up the device for the first time
3	Making and terminating a communications session (phone calls, videos call or text message session)
4	Receiving communication session (phone calls, videos call or text message session)
5	Sending text messages to a person in their contact list and to a specific phone number
6	Receiving text messages
7	Send and Receiving email using an app
8	Using a web browser to navigate to a URL, scroll to the end of the URL, interact with the controls on the webpage, enter text in the edit controls on that webpage and the browser controls (reload, forward and back, menu for browser).
9	Using a calendar including entering a new appointment for a date one month in the future and looking up an appointment already scheduled for this week.
10	Taking pictures/video and save it to the mobile device
11	Watching videos or listening to music including changing volume
12	Complete a video call or meeting (FaceTime, no equivalent in Android that is shipped with phone - Duo).
13	Receive low battery notification
14	Change setting one the mobile device such as display brighten, default font size
15	Turn on the power to the phone
16	Turn off the power to the phone
17	Turn volume up
18	Turn volume down
19	Charge the mobile device

23.3EN 301 549 Conformance Report

The following specifications from the EN 301 549 standard are used to define the accessibility of mobile devices in a checklist format. Note that the specifications do not necessarily guarantee a specific set of accessibility solutions will be available on a specific mobile device nor that the solutions

that are available will allow a person to complete the list of primary tasks outlined above. Refer to the section on Best Practices in the template for further requirements that reference the Primary Task list.

23.4Chapter 4: Functional Performance Statements (Fps)

Notes:

Criteria	Conformance Level	Remarks and Explanations
4.2.1 Usage without vision		
4.2.2 Usage with limited vision		
4.2.3 Usage without perception of color		
4.2.4 Usage without hearing		
4.2.5 Usage with limited hearing		
4.2.6 Usage with no or limited vocal capability		
4.2.7 Usage with limited manipulation or strength		
4.2.8 Usage with limited reach		
4.2.9 Minimize photosensitive seizure triggers		

4.2.10 Usage with limited cognition, language or learning		
4.2.11 Privacy Chapter 5: Generic Requirements		

23.5 Chapter 5: Generic Requirements

Notes:

Criteria	Conformance Level	Remarks/Explanations
5.1 Closed functionality		
5.1.2 General Heading		
5.1.2.1 Closed functionality	See 5.2 through 13	See information in 5.2 through 13
5.1.2.2 Assistive technology	See 5.1.3 through 5.1.6	See information in 5.1.3 through 5.1.6
5.1.3 Non-visual access		
5.1.3.1 Audio output of visual information		
5.1.3.2 Auditory output delivery including speech		
5.1.3.3 Auditory output correlation		
5.1.3.4 Speech output user control		

5.1.3.5 Speech output automatic interruption		
5.1.3.6 Speech output for non-text content		
5.1.3.7 Speech output for video information		
5.1.3.8 Masked entry		
5.1.3.9 Private access to personal data		
5.1.3.10 Non-interfering audio output		
5.1.3.11 Private listening volume		
5.1.3.12 Speaker volume		
5.1.3.13 Volume reset		
5.1.3.14 Spoken languages		Canada has two official languages: French and English. For government purposes support outside of those two languages is not mandatory.
5.1.3.15 Non-visual error identification		
5.1.3.16 Receipts, tickets, and transactional outputs		Not applicable for mobile devices

5.1.4 Functionality closed to text enlargement		
5.1.5 Visual output for auditory information		
5.1.6 Operation without keyboard interface		
5.1.6.1 Closed functionality		See information in 5.1.3.1 through 5.1.3.16
5.1.6.2 Input focus		
5.1.7 Access without speech		
5.2 Activation of accessibility features		
5.3 Biometrics		
5.4 Preservation of accessibility information during conversion		
5.5 Operable parts		
5.5.1 Means of operation		
5.5.2 Operable parts discernibility		
5.6 Locking or toggle controls		
5.6.1 Tactile or auditory status		

5.6.2 Visual status		
5.7 Key repeat		
5.8 Double-strike key acceptance		
5.9 Simultaneous user actions		

23.6 Chapter 6: ICT with Two-Way Voice Communication

Notes:

Criteria	Conformance Level	Remarks/Explanations
6.1 Audio bandwidth for speech		
6.2 Real-time text (RTT) functionality		
6.2.1.1 RTT communication		
6.2.1.2 Concurrent voice and text		
6.2.2.1 Visually distinguishable display		
6.2.2.2 Programmatically determinable send and receive direction		
6.2.2.3 Speaker identification		

6.2.2.4 Visual indicator of Audio with RTT		
6.2.3 Interoperability		
6.2.4 RTT responsiveness		
6.3 Caller ID		
6.4 Alternatives to voice-based services		
6.5 Video communication		
6.5.1 General (informative)		
6.5.2 Resolution		
6.5.3 Frame rate		
6.5.4 Synchronization between audio and video		
6.5.5 Visual indicator of audio with video		
6.5.6 Speaker identification with video (sign language) communication		
6.6 Alternatives to video-based services (advisory only)		

23.7 Chapter 7: ICT with Video Capabilities

Criteria	Conformance level	Remarks/Explanations
7.1 Caption processing technology		
7.1.1 Captioning playback		
7.1.2 Captioning synchronization		
7.1.3 Preservation of captioning		
7.1.4 Captions characteristics		
7.1.5 Spoken subtitles		
7.2.1 Audio description playback		
7.2.2 Audio description synchronization		
7.2.3 Preservation of audio description		
7.3 User controls for captions and audio description		

23.8 Chapter 8: Hardware

Criteria	Conformance Level	Remarks/Explanations
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8.1.1 Generic requirements		
8.1.2 Standard connections		
8.1.3 Color		
8.2 Hardware products with speech output		
8.2.1.1 Speech volume range		
8.2.1.2 Incremental volume control		
8.2.2.1 Fixed-line devices		Not applicable for mobile devices
8.2.2.2 Wireless communication devices		
8.3 Stationary ICT		Not applicable for mobile devices
8.3.2.1 Unobstructed high forward reach		Not applicable for mobile devices
8.3.2.2 Unobstructed low forward reach		Not applicable for mobile devices
8.3.2.3.1 Clear space		Not applicable for mobile devices
8.3.2.3.2 Obstructed (< 510 mm) forward reach		Not applicable for mobile devices

8.3.2.3.3 Obstructed (< 635 mm) forward reach		Not applicable for mobile devices
8.3.2.4 Knee and toe clearance width		Not applicable for mobile devices
8.3.2.5 Toe clearance		Not applicable for mobile devices
8.3.2.6 Knee clearance		Not applicable for mobile devices
8.3.3.1 Unobstructed high side reach		Not applicable for mobile devices
8.3.3.2 Unobstructed low side reach		Not applicable for mobile devices
8.3.3.3.1 Obstructed (≤ 255 mm) side reach		Not applicable for mobile devices
8.3.3.3.2 Obstructed (≤ 610 mm) side reach		Not applicable for mobile devices
8.3.4.1 Change in level		Not applicable for mobile devices
8.3.4.2 Clear floor or ground space		Not applicable for mobile devices
8.3.4.3.2 Forward approach		Not applicable for mobile devices
8.3.4.3.3 Parallel approach		Not applicable for mobile devices

8.3.5 Visibility		
8.3.6 Installation instructions		
8.4 Mechanically Operable parts		
8.4.1 Numeric keys		
8.4.2.1 Means of operation of mechanical parts		
8.4.2.2 Force of operation of mechanical parts		
8.4.3 Keys, tickets and fare cards		
8.5 Tactile indication of speech mode		

23.9 Chapter 9: Web (see WCAG 2.x section)

Notes:

WCAG 2.x Report

Conformance with EN 301 549. Applicable sections:

- Chapter 9 - Web
- Sections 10.1-10.4 of Chapter 10 - Non-Web documents
- Sections 11.1- 11.4 and 11.8.2 of Chapter 11 - Software (open and closed functionality)
- Sections 12.1.2 and 12.2.4 of Chapter 12 - Documentation

23.10 Chapter 10: Non-web Documents

Notes:

Criteria	Conformance Level	Remarks/Explanations
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10.0 General (informative)		
10.1.1.1 through 10.4.1.3		See information in WCAG 2.x section
10.5 Caption positioning		
10.6 Audio description timing		

23.11 Chapter 11: Software

Criteria	Conformance level	Remarks/Explanations
11.0 General (informative)		
11.1.1.1 through 11.4.1.3	See WCAG 2.x section	
11.5 Interoperability with assistive technology		
11.5.1 Closed functionality		
11.5.2 Accessibility services		
11.5.2.1 Platform accessibility service support for software that provides a user interface		See information in 11.5.2.5 through 11.5.2.17

11.5.2.2 Platform accessibility service support for assistive technologies		See information in 11.5.2.5 through 11.5.2.17
11.5.2.3 Use of accessibility services		See 11.5.2.5 through 11.5.2.17
11.5.2.4 Assistive technology		
11.5.2.5 Object information		
11.5.2.6 Row, column, and headers		
11.5.2.7 Values		
11.5.2.8 Label relationships		
11.5.2.9 Parent-child relationships		Not applicable for government procurement?
11.5.2.10 Text		
11.5.2.11 List of available actions		
11.5.2.12 Execution of available actions		
11.5.2.13 Tracking of focus and selection attributes		

11.5.2.14 Modification of focus and selection attributes		
11.5.2.15 Change notification		
11.5.2.16 Modifications of states and properties		
11.5.2.17 Modifications of values and text		
11.6 Documented accessibility usage		
11.6.1 User control of accessibility features		
11.6.2 No disruption of accessibility features		
11.7 User preferences		
11.8 Authoring tools Heading		
11.8.1 Content Technology		
11.8.2 Accessible content creation		See WCAG 2.x section (If not authoring tool, enter “Not Applicable”)
11.8.3 Preservation of accessibility information in transformations		
11.8.4 Repair assistance		

11.8.5 Templates		

23.12 **Chapter 12: Documentation and Support Services**

Criteria	Conformance Level	Remarks/Explanations
12.1 Product documentation Heading		
12.1.1 Accessibility and compatibility features		
12.1.2 Accessible documentation		See information in WCAG 2.x section
12.2 Support Services Heading		
12.2.2 Information on accessibility and compatibility features		
12.2.3 Effective communication		
12.2.4 Accessible documentation		See information in WCAG 2.x section

23.13 **Chapter 13: ICT Providing Relay or Emergency Service Access**

Criteria	Conformance Level	Remarks/Explanations
13.1 Relay services requirements Heading		

13.1.2 Text relay services		
13.1.3 Sign relay services		
13.1.4 Lip-reading relay services		Service not available in Canada
13.1.5 Captioned telephony services		Service not available in Canada
13.1.6 Speech to speech relay services		Service not available in Canada
13.2 Access to relay services		
13.3 Access to emergency services		

23.14 Enhanced Criteria

NOTE FOR REVIEWERS: This section will typically contain additions, explicit omissions and modifications to the EN 301 549 specifications. In this case we currently only have additions.

Criteria	Source	Conformance	Remarks/Explanations
Section 508: 408.3 Flashing. Where ICT emits lights in flashes, there shall be no more than three flashes in any one-second period.	Home Section508.gov		

<i>Section 508: 411.1 General.</i> Where provided, audible signals or cues shall not be used as the only means of conveying information, indicating an action, or prompting a response.	Home Section508.gov		

23.15 Best Practice Implementations

To make the selection process easier if your product implements a best practice, please declare that here. Refer to Section 11 of this document.

In order for your implementation of a best practice to be considered a solution, it must be able to complete all the tasks on the Primary Task List without reliance on other functions or applications that are not considered directly part of the solution. For example, if a specific task on the mobile device requires a gesture to do a screen capture, if the solution does not include a method to explicitly do the equivalent action to active a screen capture and screen capture is on the primary task list then the solution is not considered an equivalent appropriate solution.

In this section, if the device has implemented one or more of the best practices describe how the solutions have been tested to ensure it can complete every task on the primary task list that has been supplied by the procuring agency. In the case where the procuring agency requires that the mobile device have solutions for all disability communities and groups within each community, a best practice or equivalent solution must be provided for each group within each community. See section 19 on how equivalent solutions are evaluated and the testing data that is required to be submitted to make a declaration of equivalent functionality.

User Community	Group within the Community	Best Practice	Conformance	Remarks /Explanations
Hearing				
	Mild		Does the solution allow users to complete every task on the primary task list? (Yes/No).	Provide testing data.
	Moderate			
	Severe			
Mobility Loss				
	Mild			
	Moderate			
	Severe			
Vision Loss				
	Mild			
	Moderate			
	Severe			
Cognitive				
	Group 1			
	Group 2			
	Group 3			
Speech Loss				
	Low Audio Acuity			
	Alternative and Augmentative Communications User			

23.16 Legal Disclaimer (Company)

Include your company legal disclaimer here, if needed

24 Functional Testing

While the supplier and manufacturer will fill out the DAC. The DAC itself is often not sufficient to guarantee the accessibility of a mobile device in all potential use cases. The supplier or manufacturer may have filled out their declaration wrong or they may have mis-interpreted the criteria. The DAC is unique in that it not only requires the existence of accessible features but that those features be able to complete a specific list of tasks without reference to features not explicitly included as part of the solution for a specific persona.

Third party testing either externally or internally by the purchasing agency is recommended. Each of the proposed solutions for each persona should be tested to ensure they can complete each task on the primary task list. As the testing is task specific there is no need to evaluate individual features of the solution to make sure they comply with the specification. Where different government agencies are doing independent testing, it may be more efficient to share the results. Making sure the results are up to date.

25 End User Acceptance Process

The end user must be part of the testing and acceptance process. They should have been part of the procurement process when the procurement document was created but it is recognized that this is not possible in all cases. As the end user ultimately must use the device, they should be allowed to use the device to try to complete the critical tasks needed in their job role. The department requesting the device also may have expectations on how quickly and efficiently the end user must be able to complete the tasks the end user needs to do to do their job and how much time is allowed for the end user to learn how to use the device. As the testing is task specific no elaborate testing needs to be done to test specific aspects of the accessibility solution.

26 Conformance Testing of Solutions for Compliance with The Guidelines Above

To test if a product complies with the technical requirements that define the accessibility for this community manufacturer and procurement department can use the following procedure:

<https://www.section508.gov/test/testing-overview>

Manual testing is suggested as being more complete and effective. More details are provided in the Section 12: Testing Process for a New Accessible Solution.

27 Testing Process for a New Accessible Solution

Mobile devices are consistently being improved and updated to add new features and services. As their capabilities improve new accessibility solutions may be developed. It is impossible to develop strict, prescriptive criteria that determines the accessibility of a device or the suitability of a new accessibility solution before it is created. As an alternative this section presents a framework for testing a new accessibility solution for a specific device or classes of device for a specific subgroup of a community of users. The subgroups are determined by the severity levels described in this document as most solutions are not designed to address the consideration of all severity levels.

The testing process is constructed around a list of tasks as described in Section 9.2: Specific tasks for mobile devices. That list is repeated here to make it easy to reference.

#	Task
1	Reading the instructions on how to use the device that comes with the device packaging or is available from an online source
2	Setting up the device for the first time
3	Making and terminating a communications session (phone calls, videos call or text message session)
4	Receiving communication session (phone calls, videos call or text message session)
5	Sending text messages to a person in their contact list and to a specific phone number
6	Receiving text messages

7	Send and Receiving email using an app
8	Using a web browser to navigate to a URL, scroll to the end of the URL, interact with the controls on the webpage, enter text in the edit controls on that webpage and the browser controls (reload, forward and back, menu for browser). Sample test URL:
9	Using a calendar including entering a new appointment for a date one month in the future and looking up an appointment already scheduled for this week.
10	Taking pictures/video and save it to the mobile device
11	Watching videos or listening to music including changing volume (to be discuss App or web based??? Caption configurable ?????)
12	Complete a video call or meeting (FaceTime, no equivalent in Android that is shipped with phone - Duo).
13	Receive low battery notification
14	Change setting one the mobile device such as display brighten, default font size
15	Turn up the volume
16	Turn down the volume
17	Turn on the power to the device
18	Turn off the power to the device
19	Plug in the mobile device to charge it

When testing a new class of accessibility solutions, considerations must be taken to address the list of performance metrics supplied with each of the personas that represent levels of severity and correspond to key sub-groups of users within a particular disability community. Combinations of those performance metrics represent the abilities of the sub-groups of users within each community. A particular accessibility solution usually addresses one sub-group of users due to their unique combination of abilities described by the performance metrics. While there may be cases where a solution addresses the needs of multiple sub-groups of users, the appropriateness of a solution as

measured by efficiency (time to perform the task) usually helps to define the sub-group of users the solution is most appropriate for. The concept of it being “not impossible” to complete a task using a particular solution historically has led to suppliers creating or providing only a solution for the most severe level of a disability community and assumes anyone with more ability can also use the same solution. The definition of appropriateness takes into the consideration of the end users’ abilities so they can complete a task in the most effective and efficient manner possible given their abilities.

For the evaluation process the supplier is assumed to be providing a solution or solutions that meet the needs of each one of the levels of severity described in the personas section. A solution can then be evaluated against users with the combination of performance metrics provided for each severity level. The solution must be able to complete each task in the primary task list plus any additional tasks specified in the purchasing document that are critical to the end user’s needs. This will include those needs dictated by the employer of the end user. Examples are applications the end user must complete as part of their job or any technical compatibility issues required by the information technology division of the organization.

To be accepted as a solution for a particular subgroup or sub-groups, a user with the related performance metrics for that sub-group must be able to complete all the tasks on the list without having to resort to additional features of applications that are not directly part of the solution. Completing part of the tasks using one accessibility solution and another part of the task using another accessibility solution are not considered an appropriate solution that passes the test criteria.

For simplicity, the following reporting format will be used:

#	Task	Result of test with accessibility solution	Notes
1	Reading the instructions on how to use the device that comes with the device packaging or is available from an online source		

2	Setting up the device for the first time		
3	Making and terminating a communications session (phone calls, videos call or text message session)		
4	Receiving communication session (phone calls, videos call or text message session)		
5	Sending text messages to a person in their contact list and to a specific phone number		
6	Receiving text messages		
7	Send and Receiving email using an app		
8	Using a web browser to navigate to a URL, scroll to the end of the URL, interact with the controls on the webpage, enter text in the edit controls on that webpage and the browser controls (reload, forward and back, menu for browser). Sample test URL:		
9	Using a calendar including entering a new appointment for a date one month in the future and looking up an appointment already scheduled for this week.		

10	Taking pictures/video and save it to the mobile device		
11	Watching videos or listening to music including changing volume (to be discuss App or web based??? Caption configurable ?????)		
12	Complete a video call or meeting (FaceTime, no equivalent in Android that is shipped with phone - Duo).		
13	Receive low battery notification		
14	Change setting one the mobile device such as display brighten, default font size		
15	Turn up volume on device		
16	Turn down volume on device		
17	Turn on power on the device		
18	Turn off power on the device		
19	Plug in device to charge it		

The results of an attempt to complete a task from the list can have one of three outcomes:

- Pass
- Fail
- Pass with exceptions

Pass denotes that the solution could complete each phase of the task without relying on features or applications that are not part of the solution and available to users that do not have the restrictions imposed by the performance metrics of the end user. Fail denotes the solution was not able to complete all phases of the task. Pass with exceptions denotes the solution could complete most but not every phase of the task without relying on features or applications that are not part of the solution and available to users that do not have the

restrictions imposed by the performance metrics of the end user. The nature of the exception and the reason the solution failed should be described in detail in the Notes section of the reporting table. Purchases may determine the phone is intended for a subset of the users and they may deem the exception acceptable to their end users.

28 Appendix A: Specifics of the CVAA

28.1 What Does the CVAA Mean by “Accessible”?

The CVAA and Federal Communications Commission (FCC) regulations determine accessibility by looking at two things: How the service is used, and the availability of the information to individuals with disabilities. On usability, the FCC determines whether the “input, control, and mechanical functions” are “locatable, identifiable, and operable” to people with disabilities. Service providers must offer at least one function to make their product usable by individuals who:

- Are blind or low vision;
- Have limited vision **and** are deaf or hearing impaired;
- Are colorblind;
- Are deaf or hearing impaired;
- Have limited manual dexterity;
- Have limited reach or strength;
- Use a prosthetic device;
- Are mute or unable to speak; or
- Have limited cognitive skills.

Service providers are also required to make their products usable without time-dependent controls while also ensuring the “information necessary to operate and use the product, including but not limited to, text, static or dynamic images, icons, labels, sounds, or incidental operating cues” are available to users with disabilities. For example:

- Text and other visual information (pictures, charts, etc.) must be available in auditory form and must also be accessible for users with impaired vision or hearing (e.g., high contrast, able to be magnified);
- Moving text must also be available in a static form; and

Finally, FCC regulations also require manufacturers to make products more inclusive to people with disabilities by:

-

The FCC may waive the CVAA requirements for specific features or classes of services, but only in a limited number of cases. One of them being for basic e-readers. Back in February 2014, the [FCC extended](#) the waiver of Advanced Communications Services Accessibility Requirements for basic e-readers that will end February 1st, 2019. It provided a waiver for basic e-readers (such as the Amazon Kindle) under the [conditions](#) that the device:

- Doesn't have an LCD screen but still features a screen that is designed to optimize reading.
- The device does not have a camera.
- The device is not offered or shipped to consumers with built-in ACS client applications and the device manufacturer does not develop ACS applications for its respective device, but the device may be offered or shipped to consumers with a browser and social media applications.
- The device is marketed as a reading device, and all the promotional material about the device does not tout the capability to access ACS.

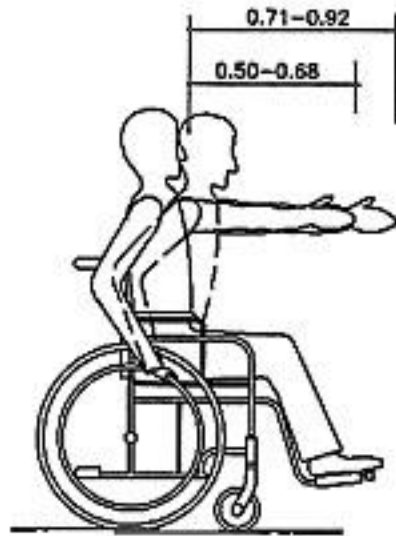
The waiver, which ended in February of this year, requires that the E-Reader Coalition submit a report which includes a study of the technological development, marketing, and consumer use trends in the basic e-reader market. After submission, the FCC will decide whether to make any further adjustments to the waiver, including termination. Their decisions will rely largely on if the FCC determines that ACS has become a primary or co-primary purpose of these devices.

28.2 Key Takeaways

- Under the CVAA, providers of Advanced Communications Services are required to be accessible and usable by disabled users.
- Advanced Communications Services is a descriptor for newer, internet-based communication systems that were not regulated by existing communications laws.

- The CVAA and FCC regulations determine accessibility by looking at how the service is used and the availability of the information to individuals with disabilities.”^{130, 131, 132}

29 Appendix B: Text size



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The required text size for an individual with mild or no vision impairment depends on many factors that are difficult to programmatically determine. Some examples include:

- Luminance contrast,
- Font weight and style,
- Screen glare,
- Environmental lighting,
- Screen size and pixel density (DPI),
- Screen technology (depth of black and/or white),
- Movement of screen (a handheld device), and
- Viewing distance.

⁷⁰ “Accessibility for the Disabled - A Design Manual for a Barrier Free Environment.” United Nations. <https://web.archive.org/web/20190704011656/https://www.un.org/esa/socdev/enable/designm/AD5-02.htm>

These factors are accommodated in the EN 301 549 V3.1.1 (2019-11): Accessibility requirements for ICT products and services.⁷¹ Where a minimum font height is specified for ICT that has no user adjustment for font height.



Figure 1: Relationship between minimum character height and maximum design viewing distance

The graph above shows the relationship between design viewing distance and minimum character height at the limit of subtended angle of 0.7 degrees. The assumption for this graph assumes the user can distinguish features that are 0.7-degree angle of view under all viewing conditions. The measurement uses a non-accented capital "H" to take the measurement.

Using the graph above you can calculate the optimal minimum text height based the viewing distance using this formula:

$$\text{Minimum Text Height} = 0.0122179 * \text{Viewing Distance}$$

Using the data above related to the range of average arm lengths (0.5 to 0.68 m) and text height ranges from 6.1 mm to 8.3 mm. (0.24 inches to 0.33 inches). The recommended minimum large font or point of interest height should follow this formula for legibility.

⁷¹ https://www.etsi.org/deliver/etsi_en/301500_301599/301549/03.01.01_60/en_301549v030101p.pdf

30 Appendix C: New Standard for Braille Displays is on the Horizon

On May 31, (2018) the Universal Serial Bus Implementers Forum (USB-IF) approved a new Human Interface Device (HID) standard for braille displays. USB-IF is a non-profit organization comprising many industry-leading companies such as Microsoft, Apple and Google. Their goal is to advance USB technology to make it more useful for consumers. According to the [USB-IF press release](#), the standard will "make it easier to use a braille display across operating systems and different types of hardware. It will also simplify development, removing the need for braille devices to have custom software and drivers created for a particular operating system or screen reader."

August 2018

[New Standards for Braille Displays are on the Horizon | AccessWorld | American Foundation for the Blind \(afb.org\)](#)

How To Read & Write Braille + The History of Braille!

[How To Read & Write Braille + The History of Braille! - YouTube](#)

31 Appendix D: Enhanced Accessibility Solutions

Some features or solutions that are designed to accommodate the needs of people with vision loss are not considered primary solutions. Primary solutions are solutions that allow the end user to complete all the tasks on the primary task list without using additional features or solutions that are not part of the solution. The primary task list is detailed in a table in Section 12. These features or solutions are considered enhancements if they enhance one or more primary solutions but are not a “complete” solution on its own.

A partial but not complete list is provided below of solutions that exist on mobile devices. It should be noted as these solutions/features are considered enhancement they are not mandatory requirements for the purpose of this

document. These enhancements were developed to meet a specific need though and they should not be dismissed as unnecessary. In some cases, the performance may not be sufficient for categorization as a primary solution.

Be My Eyes App: Demonstration and Review. An App for Blind, Low Vision, and Visually Impaired

<https://www.youtube.com/watch?v=eo2P9guQtz4>

Aira App for the Blind and Visually Impaired | Visual Interpretation on demand

Service that described things around you through an agent

[Aira App for the Blind and Visually Impaired | Visual Interpretation on demand #LiveAccessible - YouTube](#)

How To Setup An iPhone or iPad For Low Vision or Blindness

Use SIRI to turn on VoiceOver. Change background for low vision to give better contrast. Avoid dynamic wallpaper due to movement and parallax effects, wasted preference. Use a static background. Preference for solid black normally. Can also download custom wallpaper. Customize brightness. (How bright???). Can use display zoom in large iPads. Full-screen zoom vs window for zoomed area. Smart invert screen so as to not affect photos and icons.

Accessibility font even exceeds the default large font

Turn transparency off to make notifications easier to read

Reduce motions to make it easier to see

Shortcut for HOME button

Shortcuts to launch specific features

Shortcut to turn off Voice Over preference

Can create multiple shortcuts

Change voice of SIRI and Voice Over

<https://www.youtube.com/watch?v=IrUMYePxzfM>

Gestype: Inclusive keyboard app for low-vision and blind users

- Keyboard entry is slow and time consuming
- Gestype splits screen in 2. 4 directions and double taps, hold changes screen movement definitions.
- Requires support for third party keyboards – only recently available in IOS
-

<https://www.youtube.com/watch?v=LW-auK5HA8g>

How a blind/visually impaired person uses a phone #BlindPeopleUsePhones

- Can use large fonts and accessibility features provide even larger fonts
- Can use magnifier on Apps that does not make font big enough
- Invert color for low contrast or people that are sensitive to light
- Voice Over and Talk Back
- Voice dictation to enter text
- Braille Screen Input
- Seeing AI App identifies documents
- Be My Eyes guide you around

<https://www.youtube.com/hashtag/blindpeopleusephones>

SmartVision 2 - Smartphone for The Visually Impaired - The Blind Life 2018

- Android phone
- Has a numeric keypad
- SOS button on the back
- Simple linear stripped-down interface
- Has direction pad on physically keyboard

- Has extra-large font during phone dialing
- Dedicated dictation button
- Support gestures to scroll up on – TalkBack
- Support T9 on physical keypad

<https://www.youtube.com/watch?v=PzwehPHrmSs>

HIGH CONTRAST KEYBOARDS for the LOW VISION on Samsung Galaxy Note 10 | Tech with The Blind Lady

- Keyboard turns to yellow when the shift lock is on.

[HIGH CONTRAST KEYBOARDS for the LOW VISION on Samsung Galaxy Note 10 | Tech with The Blind Lady - YouTube](#)

BlindShell Classic: Phone for the Blind and Visually Impaired | Review #LiveAccessible 2019

- Physically numeric keyboard and puck
- Left and right on puck to move up and down list of Apps
- Press centre of puck to select
- Large font or icon to show current App available
- End call button to go back or exit App
- Can change color of scheme
- SOS button on back of phone
- Linear display of icons or text
- Can feel contact to detect orientation of battery
- Apps in list are numbered so you can use the numbers on keypad to access directly
- Up and down volume buttons on front of phone
- Holding volume button launches voice assistant

https://www.youtube.com/watch?v=XSE8grhy_8g

Example of Keyboard Input for Low Vision Users.

Low-Vision Tech ~ Google Keyboard

Reviews suggest they cannot use Swype due to their eyes. Prefer darker, higher contrast keyboard. Third party Google keyboard has a high contrast mode. Handwriting mode is a viable option.

Google keyboard:
[https://play.google.com/store/apps/details?id=com.google.android.inputmeth
od.latin](https://play.google.com/store/apps/details?id=com.google.android.inputmethod.latin)

Google Handwriting: Does not exist anymore.

<https://www.youtube.com/watch?v=ZrPlwIEDqW4>

BlindShell - Mobile Phone for The Visually Impaired 2019

Has physical buttons (number keypad, puck, navigation buttons). SOS button on back of phone. Large high contrast icons. Can replace icons with text. Size of text customizable. Everything has TTS capability enabled.

<https://www.youtube.com/watch?v=5YGW1eXMLcQ>

Reference Articles

MAKING TOUCH-BASED MOBILE PHONES ACCESSIBLE FOR THE VISUALLY IMPAIRED Alexander Dreyer Johnsen – 0834060

[\(1\)\(PDF\) MAKING TOUCH-BASED MOBILE PHONES ACCESSIBLE FOR THE VISUALLY IMPAIRED | Alexander Dreyer Johnsen - Academia.edu](#)

BIG KEYS Large Print iPad Keyboard low vision visual impairment app

Extra large keys for poor dexterity and extra larger font for iPad

Mirror QWERTY Keyboard

Number along top change to symbol by hitting a special key

Can change foreground and background color for better contrast

Has invert mode for better contrast also

Key and gesture to delete whole words – swipe delete key

Can skip letters instead of retyping it.

Long press for accent letter

Large-print-apps.com

<https://www.youtube.com/watch?v=LLZVVER0yllI>

What's the BEST Screen Size for Low Vision? Is the answer bigger?
#LiveAccessible

- Low peripheral vision and low acuity means the screen needs to be close to focus so big fonts causes excessive scanning to perceive everything
- Big is not always the right choice
- Resolution is not always relevant for low vision on small screens

[What's the BEST Screen Size for Low Vision? Is bigger the answer?
#LiveAccessible - YouTube](#)

Low Vision Miami - KeyBoard Large Print- for Visually Impaired

- 1-inch square keys
- High contrast lettering on keys
- High contrast color combination font to key background
-

[Low Vision Miami - KeyBoard Large Print- for Visual Impaired - YouTube](#)

Low vision: the bigger picture

[Low vision: the bigger picture - YouTube](#)