Are PDF Documents Accessible?

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Adobe PDF is one of the most widely used formats in scientific communications and in administrative documents. In its latest versions it has incorporated structural tags and improvements that increase its level of accessibility. This article reviews the concept of accessibility in the reading of digital documents and evaluates the accessibility of PDF according to the most widely established standards.

In a world in which an increasing amount of information is circulating in digital format, document accessibility is becoming a major concern. Many countries have adopted legislative measures concerning digital accessibility (see, for example, the Web Accessibility Initiative at www.w3.org/WAI/Policy) and the guru of the Web, Jakob Nielsen, has included it in several columns (Nielsen 1996, 1999) and reports (Coyne and Nielsen 2001a, 2001b, 2001c; Schade and Neilsen 2002).

Improving document accessibility for disabled persons, including the elderly, offers good business opportunities for IT firms. For example, Sun has introduced strict accessibility guidelines in its Java programming language, and Microsoft has incorporated an increasing number of assistive technologies in its operating system. For its part, Adobe came out clearly in favor of accessibility in the latest updates of its flagship format, PDF, and its free Reader program (Adobe 2005).

The efforts of these and many other companies are necessary if persons with disabilities are to be able to use products as well as persons without disabilities. In an effect similar to that of the cascade of interactions that takes place in the search for information in a digital library (Bates 2002), the accessibility of a digital product is contextual and depends on many layers: the product itself, the application used to operate it, the support of the operating system, and the additional assistive technologies used to transform the content (Henry 2007). For example, an HTML document is considered to be accessible if it complies with the *Web Content Accessibility Guidelines (WCAG 1.0)* (W3C 1999, W3C 2006), but it is only usable if the browser with which it is consulted provides the options of accessibility (e.g., by allowing users to modify the associated style sheet), if the user has the necessary assistive technologies—screen magnifiers, screen readers, alternate pointing devices, etc.—to use the information and functionality contained in the document, and if all these tools interact correctly with each other.

This article focuses on the accessibility of the PDF due to its importance in the world of digital publishing. Though we do not have global statistics on its use, a Google search specifying PDF as the format returns 236 million documents, whereas none of the other recoverable formats reaches 50 million documents (Postscript 10 million, Microsoft Word 37 million, Microsoft Excel 14 million, Microsoft PowerPoint 14 million). (The search was performed on April 14, 2007, with the arguments filetype:pdf, etc. Values were rounded off to the nearest million.) It should be remembered that PDF is the main format used for digital publishing of electronic journals and for a great variety of administrative documents, including e-government communications. Furthermore, the subformat PDF/A for archiving is the preferred format for digital preservation in many large libraries, including the Library of Congress, which recommends it for textual documents in which the appearance is more relevant than the structure (Library of Congress 2005). Finally, according to a study by Forrester Research in 2005, PDF/A and XML will be the dominant formats in document archiving in 2008 (Markham 2005). If our digital memory is going to be in PDF, we must ensure that it is accessible to all persons.

So far, the many studies that have been carried out on the accessibility of digital information have considered mainly the accessibility of Web content in HTML. Digital documents in a broad sense have never been evaluated from an accessibility viewpoint, and the only user studies carried out on them have dealt with usability—without paying particular attention to special capacities (see Dillon 2004)—or user preferences with regard to articles in electronic format (Tenopir 2003). Because it is a very new field, few studies have concentrated on PDF accessibility, and they do not form part of the scientific literature. However, Joe Clark and Duff Johnson have published some interesting articles on the subject (see Clark 2005, Johnson 2006, 2007a, and 2007b).

What does accessible really mean?

The most widespread view of digital accessibility is the regulatory one. The concept of accessibility of digital information was mainly disseminated with the publication of *WCAG 1.0* by the World Wide Web Consortium (W3C) as the de facto standard in this area, and with its incorporation in the federal legislation of the United States. In the United States, compliance with the accessibility guidelines has been used as a requirement in calls for tenders, and in some cases bidders have been taken to court for failure to comply. From this viewpoint, an accessible application is one that is "valid," i.e., approved by the criteria of *WCAG 1.0* or Section 508 of the Rehabilitation Act (U.S. Access Board) and comply-

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ing with their established checklist (see appendixes for the detailed checklist). Products must be certifiable as accessible. To facilitate the administrative procedures for approving bids, there is great interest in the creation of automatic protocols for checking compliance. Examples of this are products such as the historic Bobby, the LIFT extension for Adobe Dreamweaver, and the new *WCAG 2.0*, which is still being revised at the time of submission of this manuscript. Some authors have evaluated digital journals and database interfaces according to their compliance with these guidelines (e.g., Coonin 2002; Stewart, Narendra, and Schmetzke 2005). See the importance of the concept "programmatically determined" in the draft version of *WCAG 2.0* (W3C 2006).

The international standard defined by ISO 16071:2003 offers a different definition of accessibility. It considers accessibility to be "the usability of a product, service, environment, or facility by people with the widest range of capabilities" (ISO 16071:2003). In other words, accessibility is considered equivalent to usability, with the sole difference that the objective users are not specified but rather defined broadly as having "the widest range of capabilities." If we consult the standard definition of usability (ISO 9241-11:1998), we can rewrite the definition of accessibility as "the extent to which a product can be used (by users with the widest range of capabilities) to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."

Accessibility must also be measured according to the parameters of efficacy, efficiency, and satisfaction for the type of user (Hornbaek 2006). Furthermore, one should not consider the accessibility of a product in general, but rather in a given context and for given tasks. According to this definition, it would not be appropriate to state that "the website of the company company.com is accessible." We should state that "the website of the company company.com is accessible for broadband connections in office environments with the browsers Internet Explorer 6.0 or later and Mozilla Firefox 7 or later, and for commercial transactions." A new concept, the "baseline," appears is *WCAG 2.0*. It marks a great change in the philosophy of website accessibility. The baseline defines the context of the software platform, and the accessibility can be evaluated only in this context. Specifying the context is particularly important because some authors have seen a parallel between disabled users and disabling situations, which arise increasingly with the new paradigm of ubiquitous computation (Newell 1995). For example, a person suffering from deafness may have the same problems of access as a user in a noisy environment (a discotheque) or one in which silence is compulsory (a hospital or library).

Accessibility is also linked to computer manipulability. According to the MVC (Model-View-Controller) pattern, the final format or document should allow its content, its presentation, and its interactivity to be manipulated independently in order to personalize each one according to the user's preferences. For example, a webpage (content) should be navigable with a keyboard and with a mouse (control), and should be viewable with different font sizes, color contrasts, etc. (presentation). The separation of presentation and content, for example, through cascading style sheets (CSS), is thus highly desirable. However, there are also other aspects of digital formats related to computer manipulability. For example, it is considered that an open format is more accessible than a proprietary format because it is easier to develop assistive technologies to take advantage of its potential; a multiplatform format is more accessible than a format linked to a particular platform because it is adapted to a greater diversity of controls; a format that includes characteristics of internationalization is more accessible than one that does not because it can present a greater wealth of content; and a format that uses semantic encoding is more accessible than one that uses syntactic encoding because the software tools can extract more information from it.

Finally, several authors in the field of publishing (Dechilly 2004) and the field of accessible design (Paciello 2000, Petrie and Weber 2002) have related the accessibility of the digital documents to the structuring of the content and its potential transformation. Specifically, Raman (1994) defines the accessibility of a digital document as

- the amount of structural information captured by the encoding;
- the degree to which this structural information is available for processing by other applications; and
- the availability of the appropriate software needed to process this structure.

Disabilities that affect reading and assistive technologies

Returning to the definition of accessibility as being for the widest range of capabilities, it is observed that some disabilities have direct effects on digital reading and associated activities (O'Hara 1996), and that there are some well-established assistive technologies that can eliminate or minimize these effects.

There are three main groups of print disabilities that also affect the comprehension of graphics:

- All degrees of vision problems, from total blindness to reduced vision, color-blindness, and other dysfunctions. The most widely used assistive technology for total blindness is that of screen readers, which digest the information on the screen and transform it into spoken text. Reduced vision makes it difficult to read or capture the information offered; for persons with this disability, screen

magnifiers offer an optical zoom of the information shown in addition to color and contrast adjustment. In both cases additional information in the document is often required, such as explanatory subtitles for video recordings and alternative descriptions for images.

- Motor skill problems, particularly those affecting the upper extremities. This disability hinders the interaction with information and the activation of controls, links, and even linear scrolling in the document. There are a great variety of assistive technologies for persons with this disability, including pointing devices, alternative keyboards, voice synthesis technologies for activating controls, and even assistive technologies for automatic text completion.
- Different types of cognitive problems that affect reading comprehension. Those caused by dyslexia or early deafness can benefit from screen magnifiers, screen readers, and automatic text completion. Those caused by cognitive disabilities—which have not been widely studied—often require a simplified presentation of the information through graphics or very simple language.

PDF

PDF is the descendent of Postscript and is oriented toward presentation. Though recent research has experimented with new, more versatile image models (Bagley, Brailsford, and Hardy 2003), these have not yet been incorporated in the commercial format, which is still basically Postscript. PDF is a format of digital dissemination that has replicated paper documents for many years. Its faithful reproduction and portability on different platforms, in addition to a commercial policy of free dissemination of the Reader program, have given it a dominant market position among digital publishing formats. In the latest versions, PDF incorporates functions of digital management of access rights (DRM) and allows information providers to regulate the permission to view, print, extract, and modify the content.

The orientation toward presentation, which has turned PDF into the de facto standard in the publishing industry, is its main drawback for accessibility. In order to solve this, from version 1.4 onward Adobe has incorporated structural elements in the format (e.g., structural tags). This article therefore only studies the most recent versions of the format.

Despite the potential of the format, it is possible to create PDF documents of very different qualities. The application from which a PDF document is generated and the process followed in creating it directly affect the accessibility of the resulting document. Specifically, PDF can have four increasing levels of accessibility:

1. PDF image—no accessibility
2. PDF text
3. PDF text, with order
4. Tagged PDF—maximum accessibility

PDF image documents

A PDF image document is a document obtained from scanning or photographing a printed document. Its content is exclusively the bitmap resulting from the optical process. It does not allow searches in the document or text extraction because the text is only coded as a graphic.

A PDF image document is similar to a paper document in its level of accessibility. For blind persons or persons with reading problems (caused by dyslexia or early deafness) it must be transformed through an optical character recognition process in order to encode the text and adapt it to screen readers or alter the presentation. The only advantage that the digital presentation may have over a paper presentation is the possibility of optical zooming and increasing the text size to benefit persons with certain visual impairments.

PDF text documents

The second level of accessibility is that of PDF text documents, which come from the same source as image files but have gone through an optical character recognition process and incorporate the resulting text in the file. In this case it is possible to search the content, export the content to a word processor, listen to it with screen readers, and perform other types of conversion. Specifically, as of version 6 or later, Reader incorporates the possibility of removing columns, viewing the text in negative (white on black), increasing the font size, and even hearing it with a screen reader.

According to the quality of the OCR used and of the subsequent manual revision, these files often contain slight typographic errors that may affect the results of text searches and also make continued reading more difficult (especially when a screen reader is being used). If the quality of the original is poor, or it is in bad condition, OCR programs often make small mistakes. Furthermore, if the original has a creative layout in which the order of presentation does not correspond to the order of reading, the resulting text appears disordered and is therefore illegible; this problem can arise due to such common structures as footnotes, headers, and margin notes.

PDF documents with ordered text

The third level of accessibility is that of PDF text docu-

ments in which the correct reading order has been established. This can be done when the document is created or by editing it at a later stage.

Tagged PDF documents

The fourth and highest level of accessibility is when the PDF document contains ordered text and structural tags to define headers, tables, lists, etc. With this encoding, an assistive technology can present a summary of the document, facilitate navigation, provide structural information of the content, etc.

This fourth level is normally achieved only by post-processing a PDF document that has already been created. When documents are converted from the most widely used word processors to PDF, there still arise errors that must be revised manually. For example, when tables are converted from Microsoft Word to PDF, the tags are created correctly in general, but the headers of the tables are not marked up because Word does not allow them to be differentiated structurally. Another example is the conversion from Open Office 2.0, in which the documents created have major structural deficiencies.

Are PDF documents accessible?

Even at the highest level of accessibility, tagged PDF document, the aspects discussed above in the definition of accessibility must be checked. Though PDF is totally multimedia, particularly in the latest versions, and it now allows programming to be included, the commonest PDF documents are plain documents in which text and images are reproduced and the interactivity is reduced to the use of forms; these documents will thus be the ones analyzed here in an initial approach to PDF accessibility. Though this may represent a limitation, in fact it includes most of the PDF documents used for electronic journals and administrative documents.

PDF's accessibility is analyzed from the viewpoint of the end users, the readers of the document, so comments on the most widespread user agent, Reader, are also included. PDF's compliance with *WCAG 1.0*, the *WCAG 2.0* draft, and Section 508 is evaluated, and its accessibility is considered from the viewpoint of the platforms on which it runs and the programs that can be used to create documents. However, Reader and Adobe Acrobat Professional are not evaluated as authoring tools or user agents because that is not the focus of this article.

WCAG 1.0

In 1997 the W3C officially created an initiative to foster the accessibility of the Web (Engelen 2001), following the vision of its creator, Tim Berners Lee: "The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect." The Web Accessibility Initiative (WAI, www.w3.org/WAI) works with organizations around the world to develop strategies, guidelines, and resources to help make the Web accessible to people with disabilities. W3C-WAI has established three recommendations to improve the accessibility of the Web:

- *WCAG 1.0*, released in May 1999, based on the Trace Unified Web Guidelines (version 8), affecting Web content in itself (e.g., an HTML page)
- The Authoring Tool Accessibility Guidelines, affecting software used to build websites (e.g., Dreamweaver)
- The User Agents Accessibility Guidelines (UAAG), affecting browsers and multimedia players that interact with Web content (e.g., Mozilla Firefox)

Of these guidelines, the ones that have had the greatest impact are *WCAG 1.0*, because they affect content providers, such as governments. Most legislations promoting digital accessibility have made direct or indirect reference to these guidelines.

WCAG 1.0 is divided into in fourteen guidelines or general principles of accessible design, which are specified through several checkpoints. Each checkpoint has a priority level based on its impact on accessibility.

> Checkpoints of [Priority 1] are a basic requirement for some groups to be able to use Web documents. The ones of [Priority 2] will remove significant barriers to accessing Web documents. Checkpoints of [Priority 3] will improve access to Web documents (W3C 1999).

WCAG 1.0 is designed to evaluate documents, not formats, so in this article the evaluation often refers to the potential of the format if it is used properly to create documents.

PDF can potentially comply with all the checkpoints of *WCAG 1.0* applicable to text, images, and forms (its multimedia potential has not been analyzed in this article) in any priority except for three points:

5.2 Headers for tables of complex data, in Priority 1. The current version of PDF only foresees the use of TH as the header of tables, specifies attributes that allows it to be related to columns or files, but provides no mechanism for grouping cells (like COLGROUP or ROWGROUP of HTML).

3.4 Relative units in markup language attribute values and style sheet property values, in Priority 2. Though the most recent versions of PDF use CSS, the format only allows absolute values to be specified. However, this does not prevent Reader from making extensive zooms of the content of the PDF

documents.

9.5 Provide keyboard shortcuts, in Priority 3. No mechanism is specified for linking a keyboard shortcut to a content.

In both Point 4.1, for identifying changes of language, and Point 5.1, on simple table headers (both of them in Priority 1), although PDF provides for the incorporation of this information, some experiments carried out with the Acrobat Professional tools for conversion from Microsoft Word have shown that this information is not correctly transferred from the word processor to the PDF document.

For a more detailed analysis, see the tables in appendix A. Here we have only commented on the most outstanding aspects.

WCAG 2.0 draft

In the course of time *WCAG 1.0* has become out of date. The Web of 2007 is very different from that of 1999: The increased use of multimedia formats; the growth of Web-based software, AJAX, the XML subformats; and the paradigm of ubiquitous computing have made it necessary to redefine *WCAG 1.0* guidelines, which were initially highly focused on HTML, in order to extend them to all types of format; it has been considered necessary to be able to define an available software platform baseline (for a detailed discussion of the differences between *WCAG 1.0* and *WCAG 2.0*, see www.webaim.org/standards/wai/wcag2.php#differences). However, due to the enormous success of *WCAG 1.0*, the development of the *WCAG 2.0* has been subject to enormous pressure, and it has received more comments and suggestions than any other guideline of W3C. This is why the process of approval is slower than normal, and though publication dates have been repeatedly announced, the current document is no more than a draft.

WCAG 2.0 has four principles, each one addressed by several guidelines. Under each guideline there are success criteria used to evaluate conformance to this standard for that guideline, which fall into three levels of conformance, each representing a higher level of accessibility (W3C 2006).

PDF complies almost absolutely with all the success criteria of all the levels of the four principles of accessibility described in *WCAG 2.0*.

Only in Principle 3 (which establishes that both the content and the controls must be understandable), Guideline 3.1, Level 3, "Make text content readable and understandable" does *WCAG 2.0* fail in several success criteria:

3.1.3 Offer definitions for words used in an unusual way.

3.1.6 Offer the pronunciation of words where meaning cannot be determined without pronunciation.

In all of these points, the generic title attribute could be used for all the tags, but there is no standard mechanism for differentiating pronunciation or slang.

For a more detailed analysis, see the tables in appendix B. Here we have only commented on the most outstanding aspects.

Section 508 of the Rehabilitation Act

In August 2000 the U.S. Access Board (www.access-board.gov), an independent federal group that oversees the production of guidelines on accessibility for compliance with various legislative measures, published a revised amendment of the Rehabilitation Act of 1973, stating that the information provided by federal agencies must be accessible to people with disabilities (Engelen 2001). As Johnson mentions, "The regulations also apply to contractors that submit electronic documents to the federal government"(2007b).

Compliance with Section 508 is parallel to compliance with *WCAG 1.0*. PDF complies with all the points except the ability to associate data cells and header cells for tables that have more than one logical level (checkpoint h).

For a detailed analysis see the tables in appendix C. Here we have only commented on the most outstanding aspects.

Are PDF documents accessible from a computer's viewpoint?

Some doubt still remains about whether PDF is an open or closed format. It is a proprietary format, so strictly speaking it is not open, but Adobe systematically publishes the specification of format and allows it to be used by third parties free of charge, simply reserving the intellectual property rights (see Adobe 2006, 32, for the exact terms of the Adobe license). Furthermore, Adobe recently initiated the process for PDF to become an ISO standard (Adobe 2007).

The latest versions of PDF allow content and presentation to be differentiated. The content consists of the text and images, and the presentation can be encoded like webpages with some properties of CSS version 1 and 2. The control of the document depends on the program used to read it, since PDF does not allow keyboard shortcuts or alternative actions to be defined for any application. One of its main advantages is that it can be reproduced faithfully on any platform, but in terms of accessibility it is not multiplatform. The structure, links, and forms of Adobe Reader for assistive technologies are accessed through the Microsoft Active Accessibility technology, so they can only be used on Microsoft platforms. The screen reader incorporated as of Reader 6 does work on both Windows and Macintosh.

With regard to internationalization, PDF supports the UniCode character set and also allows the language of the document to be specified on a global and local level. Though the specification of the format establishes that it supports inverse reading order (e.g., for Arabic languages) or vertical reading order (e.g., for Asian languages), WebAIM (WebAIM 2006) states that it causes problems with them.

The structure in a PDF document is transmitted mainly through the tags incorporated in the format since version 1.4. The standard set of tags is fairly limited—more so than that of HTML 4 (see Adobe 2006, Sections 10.7 and 10.8, for a complete list). The set of tags can be extended but always with an equivalent with the standard set, which is the only one supported by Adobe. The structure is transmitted through the Microsoft Active Accessibility (MSAA) technology to any assistive technology, so other applications can also read it. MSAA provides agents and synthesizers in several languages that do not tend to be installed by default but can be downloaded free of charge from the Microsoft website (www.microsoft.com/msagent/downloads/user.asp). There are currently few programs that can process this structure, of which Reader is the most widespread. Among the screen readers, Jaws by FreedomScientific and Windows Eyes by GW Micro can also process PDF files on a structural level. According to Joe Clark (2005), IBM Home Page Reader and Hal Screen Reader by Dolphin can also do so. Most of these programs incorporate support for PDF in their latest versions, which are not always the most widely used.

Are PDF documents accessible according to the ISO standard?

On this topic, few studies have been made and much work remains to be done. Accessibility should be evaluated for the different types of disabilities that affect electronic reading and for different scenarios and contexts of use. Though the tests of users with disabilities are beginning to be generalized, and there are even guidelines on how to do them (Coyne and Nielsen 2001a), after an extensive bibliographic search I was unable to locate any studies evaluating this aspect in PDF.

The opinion of the experts

Joe Clark, the author of one of the most important books on website accessibility, *Building Accessible Websites* (2003), currently forms part of Adobe's work group on usability and accessibility. He is one of the greatest proponents of PDF, and claims that it offers some advantages of accessibility/usability compared with HTML (its greatest competitor for digital documents), such as its ability to use footnotes, notes, and comments. He gives little importance to the fact that it is a proprietary format and argues that the important point is that the specification is public. In his article on the accessibility of PDFs (Clark 2005), he defends the use of the format compared with others for certain objectives and needs: for interactive forms, for documents in revision, for design fonts not available in HTML, as a format of preservation, and for documents that require the management of digital rights. With regard to software, he makes a great defense of Reader for taking advantage of documents and resolving problems of accessibility, but recognizes that in the field of authoring tools more programs are necessary.

WebAIM, an initiative for accessibility at Utah State University, gives its opinion on some points that facilitate or hinder the accessibility of PDFs:

- The screen-reading function only exists in the complete version of Reader, and by no means offers the same functionality as Jaws or Windows Eyes. Furthermore, to use it one must memorize new access keys that are not common to other programs.
- The reflowing function is very useful for persons who require magnification or who work with small screens because it eliminates the horizontal scroll.
- WebAIM recommends the use of HTML for tables, particularly if they are complex, because current screen readers can process them far better than if they are in PDF.
- WebAIM criticizes the fact that the options for configuring accessibility in Reader are highly oriented toward screen readers and magnifiers, and that they are only partial and confusing. For example, it mentions the fact that it is possible to configure some multimedia options but not from the accessibility setup wizard. (WebAIM 2006)

Another aspect that receives constant criticism is the cost of creating accessible PDF documents. Though throughout this article the accessibility of PDF has been studied from the viewpoint of the user, the lack of tools for creating documents must also be stressed. Though the specification is in theory public and there exist software tools (e.g., the PDFLib software library and the XSLT transformations in Open Office) to generate tags in a PDF that are the result of a document conversion, users normally depend on the tools of Microsoft Office and the Acrobat Professional program to create accessible PDF documents. Even with these tools, editing is not as intuitive as editing a plain text tagged with HTML, and it is

far less maintainable because in PDF tags and content are encoded separately.

Conclusions

As has been seen in the analysis, PDF can be considered fairly accessible from many points of view, and its degree of compliance with the most widely recognized guidelines is fairly high. However, a surprising lack of attention is paid to complex data tables, which form a very important part of scientific articles, one of the main types of document encoded in this format. The accessibility of PDF has greatly reduced its multiplatform nature and it is to be expected that Adobe will gradually resolve this point, particularly in the Linux environment that has been adopted by many public administrations. An accessible and multiplatform PDF is a requisite for a really public electronic government.

The format still faces three major challenges with regard to accessibility:

- The creation of powerful authoring tools that allow documents to be edited easily, to be modified, and to be partially changed without having to restart the cycle of creation. There is a lack of authoring tools for creating accessible PDF documents easily and a lack of integration of the creation process in the most widely used word processors. It is to be expected that with the merger of Macromedia and Adobe these tools will shortly appear on the market.
- A greater opening of the format by Adobe in order to foster its extensibility (Adobe recently applied for PDF to become an ISA standard), which in digital articles is beginning to be a requirement for the annotation of mathematical or chemical formulas. (See, for example, the specific development of the Infty project for reading mathematical formulas in PDF [Kanahori 2006].)
- A greater wealth of tags and attributes in order to express variants, and additional or complementary information, such as definitions and pronunciation.

Despite its shortcomings, the possibilities of the PDF with regard to accessibility have increased greatly in the latest versions, and it is now almost on a level with HTML. The existence of Reader with several options for facilitating accessible reading increases its attractiveness even further. The experts recognize the giant steps made by the format, though they are aware of its limitations; for the moment their advice is to use the right format for the right task. Finally, further research is required in order to gather the opinion of users on its accessibility.

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APPENDIX A. *WCAG 1.0* checklist of checkpoints

Priority 1 checkpoints

In General (Priority 1)	Yes	No	N/A
1.1 Provide a text equivalent for every non-text element (e.g., via "alt," "longdesc," or in element content). *This includes*: images, graphical representations of text (including symbols), image map regions, animations (e.g., animated GIFs), applets and programmatic objects, ASCII art, frames, scripts, images used as list bullets, spacers, graphical buttons, sounds (played with or without user interaction), stand-alone audio files, audio tracks of video, and video.	x		
2.1 Ensure that all information conveyed with color is also available without color, for example from context or markup.	x		
4.1 Clearly identify changes in the natural language of a document's text and any text equivalents (e.g., captions).	x[1]		
6.1 Organize documents so they may be read without style sheets. For example, when an HTML document is rendered without associated style sheets, it must still be possible to read the document.	x		
6.2 Ensure that equivalents for dynamic content are updated when the dynamic content changes.			x
7.1 Until user agents allow users to control flickering, avoid causing the screen to flicker.			x
14.1 Use the clearest and simplest language appropriate for a site's content.	x		
And if you use images and image maps (Priority 1)	**Yes**	**No**	**N/A**
1.2 Provide redundant text links for each active region of a server-side image map.			x
9.1 Provide client-side image maps instead of server-side image maps except where the regions cannot be defined with an available geometric shape.			x
And if you use tables (Priority 1)	**Yes**	**No**	**N/A**
5.1 For data tables, identify row and column headers.	x		
5.2 For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells.		x	
And if you use frames (Priority 1)	**Yes**	**No**	**N/A**
12.1 Title each frame to facilitate frame identification and navigation.			x
And if you use applets and scripts (Priority 1)	**Yes**	**No**	**N/A**
6.3 Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page.			x
And if you use multimedia (Priority 1)	**Yes**	**No**	**N/A**
1.3 Until user agents can automatically read aloud the text equivalent of a visual track, provide an auditory description of the important information of the visual track of a multimedia presentation.			x
1.4 For any time-based multimedia presentation (e.g., a movie or animation), synchronize equivalent alternatives (e.g., captions or auditory descriptions of the visual track) with the presentation.			x
And if all else fails (Priority 1)	**Yes**	**No**	**N/A**
11.4 If, after best efforts, you cannot create an accessible page, provide a link to an alternative page that uses W3C technologies, is accessible, has equivalent information (or functionality), and is updated as often as the inaccessible (original) page.	x		

Priority 2 checkpoints

In General (Priority 2)	Yes	No	N/A
2.2 Ensure that foreground and background color combinations provide sufficient contrast when viewed by someone having color deficits or when viewed on a black and white screen. [Priority 2 for images, Priority 3 for text.]	x[2]		
3.1 When an appropriate markup language exists, use markup rather than images to convey information.	x[3]		
3.2 Create documents that validate to published formal grammars.	x		
3.3 Use style sheets to control layout and presentation.	x[4]		
3.4 Use relative rather than absolute units in markup language attribute values and style sheet property values.		x	
3.5 Use header elements to convey document structure and use them according to specification.	x		
3.6 Mark up lists and list items properly.	x		
3.7 Mark up quotations. Do not use quotation markup for formatting effects such as indentation.	x		
6.5 Ensure that dynamic content is accessible or provide an alternative presentation or page.			x
7.2 Until user agents allow users to control blinking, avoid causing content to blink (i.e., change presentation at a regular rate, such as turning on and off).			x
7.4 Until user agents provide the ability to stop the refresh, do not create periodically auto-refreshing pages.			x
7.5 Until user agents provide the ability to stop auto-redirect, do not use markup to redirect pages automatically. Instead, configure the server to perform redirects.			x
10.1 Until user agents allow users to turn off spawned windows, do not cause pop-ups or other windows to appear and do not change the current window without informing the user.			x
11.1 Use W3C technologies when they are available and appropriate for a task and use the latest versions when supported.			x
11.2 Avoid deprecated features of W3C technologies.			x
12.3 Divide large blocks of information into more manageable groups where natural and appropriate.	x		
13.1 Clearly identify the target of each link.	x		
13.2 Provide metadata to add semantic information to pages and sites.	x		
13.3 Provide information about the general layout of a site (e.g., a site map or table of contents).	x		
13.4 Use navigation mechanisms in a consistent manner.	x		

In General (Priority 2), cont.	Yes	No	N/A
And if you use tables (Priority 2)	**Yes**	**No**	**N/A**
5.3 Do not use tables for layout unless the table makes sense when linearized. Otherwise, if the table does not make sense, provide an alternative equivalent (which may be a linearized version).	x		
5.4 If a table is used for layout, do not use any structural markup for the purpose of visual formatting.	x		
And if you use frames (Priority 2)	**Yes**	**No**	**N/A**
12.2 Describe the purpose of frames and how frames relate to each other if it is not obvious by frame titles alone.			x
And if you use forms (Priority 2)	**Yes**	**No**	**N/A**
10.2 Until user agents support explicit associations between labels and form controls, for all form controls with implicitly associated labels, ensure that the label is properly positioned.	x		
12.4 Associate labels explicitly with their controls.	x		
And if you use applets and scripts (Priority 2)	**Yes**	**No**	**N/A**
6.4 For scripts and applets, ensure that event handlers are input-device independent.			x
7.3 Until user agents allow users to freeze moving content, avoid movement in pages.			x
8.1 Make programmatic elements such as scripts and applets directly accessible or compatible with assistive technologies. [Priority 1 if functionality is important and not presented elsewhere, otherwise Priority 2.]			x
9.2 Ensure that any element that has its own interface can be operated in a device-independent manner.			x
9.3 For scripts, specify logical event handlers rather than device-dependent event handlers.			x

Priority 3 checkpoints

In General (Priority 3)	Yes	No	N/A
4.2 Specify the expansion of each abbreviation or acronym in a document where it first occurs.	x[5]		
4.3 Identify the primary natural language of a document.	x		
9.4 Create a logical tab order through links, form controls, and objects.	x		
9.5 Provide keyboard shortcuts to important links (including those in client-side image maps), form controls, and groups of form controls.		x[6]	
10.5 Until user agents (including assistive technologies) render adjacent links distinctly, include non-link, printable characters (surrounded by spaces) between adjacent links.	x		
11.3 Provide information so that users may receive documents according to their preferences (e.g., language, content type, etc.).			x

In General (Priority 3), cont.	Yes	No	N/A
13.5 Provide navigation bars to highlight and give access to the navigation mechanism.			x
13.6 Group related links, identify the group (for user agents), and, until user agents do so, provide a way to bypass the group.	x		
13.7 If search functions are provided, enable different types of searches for different skill levels and preferences.	x[7]		
13.8 Place distinguishing information at the beginning of headings, paragraphs, lists, etc.	x		
13.9 Provide information about document collections (i.e., documents comprising multiple pages).	x		
13.10 Provide a means to skip over multi-line ASCII art.	x		
14.2 Supplement text with graphic or auditory presentations where they will facilitate comprehension of the page.	x		
14.3 Create a style of presentation that is consistent across pages.	x		
And if you use images and image maps (Priority 3)	**Yes**	**No**	**N/A**
1.5 Until user agents render text equivalents for client-side image map links, provide redundant text links for each active region of a client-side image map.			x
And if you use tables (Priority 3)	**Yes**	**No**	**N/A**
5.5 Provide summaries for tables.	x[8]		
5.6 Provide abbreviations for header labels.	x		
10.3 Until user agents (including assistive technologies) render side-by-side text correctly, provide a linear text alternative (on the current page or some other) for all tables that lay out text in parallel, word-wrapped columns.	x		
And if you use forms (Priority 3)	**Yes**	**No**	**N/A**
10.4 Until user agents handle empty controls correctly, include default, place-holding characters in edit boxes and text areas.	x		

Notes

1. This information is not correctly transferred from some word processors to the PDF format.

2. Adobe Reader allows color combinations in text to be changed.

3. The PDF tag set is very limited and does not include mathematical formulas or chemical symbols.

4. The latest versions of PDF use CSS.

5. Creators can use the E element to specify an abbreviation for a word.

6. Adobe Reader and Adobe Acrobat use generic access keys, but they cannot be specified in a document.

7. Included in Adobe Reader and Adobe Acrobat.

8. Only as of version 1.7.

APPENDIX B. *WCAG 2.0* checklist of checkpoints (draft April 2006)

Principle 1: Content must be perceivable

Guideline 1.1: Provide text alternatives for all non-text content	Yes	No	N/A
Level 1 Success Criteria for Guideline 1.1			
For all non-text content, one of the following is true: If non-text content presents information or responds to user input, text alternatives serve the same purpose and present the same information as the non-text content. If text alternatives cannot serve the same purpose, then text alternatives at least identify the purpose of the non-text content. If non-text content is multimedia; live audio-only or live video-only content; a test or exercise that must use a particular sense; or primarily intended to create a specific sensory experience; then text alternatives at least identify the non-text content with a descriptive text label. If the purpose of non-text content is to confirm that content is being operated by a person rather than a computer, different forms are provided to accommodate multiple disabilities. If non-text content is pure decoration, or used only for visual formatting, or if it is not presented to users, it is implemented such that it can be ignored by assistive technology.	x[1]		
Guideline 1.2 Provide synchronized alternatives for multimedia (not analyzed in this article)	**Yes**	**No**	**N/A**
Level 1 Success Criteria for Guideline 1.2			
1.2.1 Captions are provided for prerecorded multimedia.			
1.2.2 Audio descriptions of video, or a full multimedia text alternative including any interaction, are provided for prerecorded multimedia.			
Level 2 Success Criteria for Guideline 1.2			
1.2.3 Audio descriptions of video are provided for prerecorded multimedia.			
1.2.4 Captions are provided for live multimedia.			
Level 3 Success Criteria for Guideline 1.2			
1.2.5 Sign-language interpretation is provided for multimedia.			
1.2.6 Extended audio descriptions of video are provided for prerecorded multimedia.			
1.2.7 For prerecorded multimedia, a full multimedia text alternative including any interaction is provided.			
Guideline 1.3: Ensure that information and structure can be separated from presentation	**Yes**	**No**	**N/A**
Level 1 Success Criteria for Guideline 1.3			
1.3.1 Information and relationships conveyed through presentation can be programmatically determined, and notification of changes to these is available to user agents, including assistive technologies.	x		
1.3.2 Any information that is conveyed by color is also visually evident without color.	x		

Guideline 1.3: Ensure that information and structure can be separated from presentation, cont.	Yes	No	N/A
1.3.3 When the sequence of the content affects its meaning, that sequence can be programmatically determined.	x		
Level 2 Success Criteria for Guideline 1.3			
1.3.4 Information that is conveyed by variations in presentation of text is also conveyed in text, or the variations in presentation of text can be programmatically determined.	x		
1.3.5 Information required to understand and operate content does not rely on shape, size, visual location, or orientation of components.	x		
Guideline 1.4: Make it easy to distinguish foreground information from its background	**Yes**	**No**	**N/A**
Level 2 Success Criteria for Guideline 1.4			
1.4.1 Text or diagrams, and their background, have a luminosity contrast ratio of at least 5:1.	x		
1.4.2 A mechanism is available to turn off background audio that plays automatically, without requiring the user to turn off all audio.			x
Level 3 Success Criteria for Guideline 1.4			
1.4.3 Text or diagrams, and their background, have a luminosity contrast ratio of at least 10:1.	x		
1.4.4 Audio content does not contain background sounds, background sounds can be turned off, or background sounds are at least 20 decibels lower than the foreground audio content, with the exception of occasional sound effects.	x		

Principle 2: Interface components in the content must be operable

Guideline 2.1: Make all functionality operable via a keyboard interface	Yes	No	N/A
Level 1 Success Criteria for Guideline 2.1			
2.1.1 All functionality of the content is operable in a non-time-dependent manner through a keyboard interface, except where the task requires analog, time-dependent input. Note: This does not preclude and should not discourage the support of other input methods (such as a mouse) in addition to keyboard operation.			x
Level 3 Success Criteria for Guideline 2.1			
2.1.2 All functionality of the content is operable in a non-time-dependent manner through a keyboard interface.	x		

Guideline 2.2: Allow users to control time limits on their reading or interaction	Yes	No	N/A
Level 1 Success Criteria for Guideline 2.2			
2.2.1 For each time-out that is a function of the content, at least one of the following is true: • the user is allowed to deactivate the time-out; or • the user is allowed to adjust the time-out over a wide range that is at least ten times the length of the default setting; or • the user is warned before time expires and given at least 20 seconds to extend the time-out with a simple action (for example, "hit any key"), and the user is allowed to extend the timeout at least ten times; or • the time-out is an important part of a real-time event (for example, an auction), and no alternative to the time-out is possible; or • the time-out is part of an activity where timing is essential (for example, competitive gaming or time-based testing) and time limits can not be extended further without invalidating the activity.			x
Level 2 Success Criteria for Guideline 2.2			
2.2.2 Content does not blink for more than three seconds, or a method is available to stop all blinking content in the Web unit or authored component.			x
2.2.3 Content can be paused by the user unless the timing or movement is part of an activity where timing or movement is essential.			x
Level 3 Success Criteria for Guideline 2.2			
2.2.4 Except for real-time events, timing is not an essential part of the event or activity presented by the content.			x
2.2.5 Interruptions, such as updated content, can be postponed or suppressed by the user, except interruptions involving an emergency.			x
2.2.6 When an authenticated session expires, the user can continue the activity without loss of data after re-authenticating.			x
Guideline 2.3: Allow users to avoid content that could cause seizures due to photosensitivity	**Yes**	**No**	**N/A**
Level 1 Success Criteria for Guideline 2.3			
2.3.1 Content does not violate the general flash threshold or the red flash threshold.			x
Level 3 Success Criteria for Guideline 2.3			
2.3.2 Web units do not contain any components that flash more than three times in any one-second period.			x

Guideline 2.4: Provide mechanisms to help users find content, orient themselves within it, and navigate through it	Yes	No	N/A
Level 1 Success Criteria for Guideline 2.4			
2.4.1 A mechanism is available to bypass blocks of content that are repeated on multiple Web units.	x		
Level 2 Success Criteria for Guideline 2.4			
2.4.2 More than one way is available to locate content within a set of Web units where content is not the result of, or a step in, a process or task.			x
2.4.3 Web units have titles.			x
2.4.4 Each link is programmatically associated with text from which its purpose can be determined.	x		
Level 3 Success Criteria for Guideline 2.4			
2.4.5 Titles, headings, and labels are descriptive.	x		
2.4.6 When a Web unit or authored component is navigated sequentially, components receive focus in an order that follows relationships and sequences in the content.	x		
2.4.7 Information about the user's location within a set of Web units is available.	x		
2.4.8 The purpose of each link can be programmatically determined from the link.	x		
Guideline 2.5: Help users avoid mistakes and make it easy to correct mistakes that do occur	**Yes**	**No**	**N/A**
Level 1 Success Criteria for Guideline 2.5			
2.5.1 If an input error is detected, the error is identified and described to the user in text.	x		
Level 2 Success Criteria for Guideline 2.5			
2.5.2 If an input error is detected and suggestions for correction are known and can be provided without jeopardizing the security or purpose of the content, the suggestions are provided to the user.	x		
2.5.3 For forms that cause legal or financial transactions to occur, that modify or delete data in data storage systems, or that submit test responses, at least one of the following is true: Actions are reversible. Actions are checked for input errors before going on to the next step in the process. The user is able to review and confirm or correct information before submitting it.	x		
Level 3 Success Criteria for Guideline 2.5			
2.5.4 Context-sensitive help is available for text input.	x		

Principle 3: Content and controls must be understandable

Guideline 3.1: Make text content readable and understandable	Yes	No	N/A
Level 1 Success Criteria for Guideline 3.1			
3.1.1 The primary natural language or languages of the Web unit can be programmatically determined.	x[2]		
Level 2 Success Criteria for Guideline 3.1			

Guideline 3.1: Make text content readable and understandable, cont.	Yes	No	N/A
3.1.2 The natural language of each passage or phrase in the Web unit can be programmatically determined Note: This requirement does not apply to individual words or phrases that have become part of the primary language of the content.	x[2]		
Level 3 Success Criteria for Guideline 3.1			
3.1.3 A mechanism is available for identifying specific definitions of words or phrases used in an unusual or restricted way, including idioms and jargon.		x[3]	
3.1.4 A mechanism for finding the expanded form of abbreviations is available.	x[4]		
3.1.5 When text requires reading ability more advanced than the lower secondary education level, supplemental content is available that does not require reading ability more advanced than the lower secondary education level.	x		
3.1.6 A mechanism is available for identifying specific pronunciation of words where meaning cannot be determined without pronunciation.		x[3]	
Guideline 3.2: Make the placement and functionality of content predictable	**Yes**	**No**	**N/A**
Level 1 Success Criteria for Guideline 3.2			
3.2.1 When any component receives focus, it does not cause a change of context.	x		
3.2.2 Changing the setting of any form control or field does not automatically cause a change of context (beyond moving to the next field in tab order), unless the authored unit contains instructions before the control that describe the behavior.			x
Level 2 Success Criteria for Guideline 3.2			
3.2.3 Navigational mechanisms that are repeated on multiple Web units within a set of Web units or other primary resources occur in the same relative order each time they are repeated, unless a change is initiated by the user.	x		
3.2.4 Components that have the same functionality within a set of Web units are identified consistently.	x		
Level 3 Success Criteria for Guideline 3.2			
3.2.5 Changes of context are initiated only by user request.	x		

Principle 4: Content should be robust enough to work with current and future user agents (including assistive technologies)

Guideline 4.1: Support compatibility with current and future user agents (including assistive technologies)	Yes	No	N/A
Level 1 Success Criteria for Guideline 4.1			
4.1.1 Web units or authored components can be parsed unambiguously, and the relationships in the resulting data structure are also unambiguous.	x		
4.1.2 For all user interface components, the name and role can be programmatically determined, 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.			x

Guideline 4.2: Ensure that content is accessible or provide an accessible alternative	Yes	No	N/A
Level 1 Success Criteria for Guideline 4.2			
4.2.1 At least one version of the content meets all Level 1 success criteria, but alternate version(s) that do not meet all Level 1 success criteria may be available from the same URI.			x
4.2.2 Content meets the following criteria even if the content uses a technology that is not in the chosen baseline: If content can be entered using the keyboard, then the content can be exited using the keyboard. Content conforms to success criterion 2.3.1 (general and red flash).			x
Level 2 Success Criteria for Guideline 4.2			
4.2.3 At least one version of the content meets all Level 2 success criteria, but alternate version(s) that do not meet all Level 2 success criteria may be available from the same URI.			x
Level 3 Success Criteria for Guideline 4.2			
4.2.4 Content implemented using technologies outside of the chosen baseline satisfies all Level 1 and Level 2 requirements supported by the technologies.			x

Notes

1. Nonfunctional content can be specified using watermarks, or can simply be deleted from the reading order or the tag tree.

2. This information is not correctly transferred from some word processors to the PDF format.

3. Creators can use the title attribute to specify an alternate title for a tag.

4. Creators can use the E element to specify the abbreviation for a word.

APPENDIX C. Section 508 checklist

Section 508	PASS	FAIL	N/A
(a) A text equivalent for every non-text element shall be provided (e.g., via “alt,” “longdesc,” or in element content).	x		
(b) Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation.			x
(c) Webpages shall be designed so that all information conveyed with color is also available without color, for example from context or markup.	x		
(d) Documents shall be organized so they are readable without requiring an associated style sheet.	x		
(e) Redundant text links shall be provided for each active region of a server-side image map.			x
(f) Client-side image maps shall be provided instead of server-side image maps except where the regions cannot be defined with an available geometric shape.			x
(g) Row and column headers shall be identified for data tables.	x		
(h) Markup shall be used to associate data cells and header cells for data tables that have two or more logical levels of row or column headers.		x	
(i) Frames shall be titled with text that facilitates frame identification and navigation.			x
(j) Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz.			x
(k) A text-only page, with equivalent information or functionality, shall be provided to make a website comply with the provisions of this part, when compliance cannot be accomplished in any other way. The content of the text-only page shall be updated whenever the primary page changes.			x
(l) When pages utilize scripting languages to display content, or to create interface elements, the information provided by the script shall be identified with functional text that can be read by assistive technology. [Not evaluated in this article]			x
(m) When a webpage requires that an applet, plug-in, or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l).			x
(n) When electronic forms are designed to be completed online, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.	x		
(o) A method shall be provided that permits users to skip repetitive navigation links.	x		
(p) When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.			x