Techniques for User Agent Accessibility Guidelines 1.0

W3C Working Draft 15 January 1999

This version:
http://www.w3.org/WAI/UA/WD-UAAG-TECHS-20000115
(plain text, gzip PostScript, gzip PDF, gzip tar file of HTML, zip archive of HTML)
Latest version:
http://www.w3.org/WAI/UA/UAAG-TECHS
Previous version:
http://www.w3.org/WAI/UA/WD-WAI-USERAGENT-TECHS-19991220

Editors:
Jon Gunderson, University of Illinois at Urbana-Champaign
Ian Jacobs, W3C

Copyright © 1999-2000 W3C® (MIT, INRIA, Keio), All Rights Reserved. W3C liability, trademark, document use and software licensing rules apply.

Abstract

This document provides techniques for implementing the checkpoints defined in "User Agent Accessibility Guidelines 1.0". These techniques address the accessibility of user interfaces, content rendering, program interfaces, and languages such as the Hypertext Markup Language (HTML), Cascading Style Sheets (CSS) and the Synchronized Multimedia Integration Language (SMIL).

This document is part of a series of accessibility documents published by the Web Accessibility Initiative (WAI).

Status of this document

This section describes the status of this document at the time of its publication. Other documents may supersede this document. The latest status of this document series is maintained at the W3C.

This is a W3C Working Draft for review by W3C Members and other interested parties. It is a draft document and may be updated, replaced or obsoleted by other documents at any time. It is inappropriate to use W3C Working Drafts as reference material or to cite them as other than "work in progress". This is work in progress

and does not imply endorsement by, or the consensus of, either W3C or participants in the WAI User Agent (UA) Working Group.

While User Agent Accessibility Guidelines 1.0 strives to be a stable document (as a W3C Recommendation), the current document is expected to evolve as technologies change and content developers discover more effective techniques for designing accessible Web sites and pages.

Please send comments about this document to the public mailing list: w3c-wai-ua@w3.org. Mailing list archives are available on the Web.

This document has been produced as part of the Web Accessibility Initiative. The goals of the WAI UA Working Group are described in the WAI UA charter. A list of the UA Working Group participants is available.

A list of current W3C Recommendations and other technical documents can be found at http://www.w3.org/TR.

Table of Contents

Abstract 1
Status of this document 1
1 Introduction 4
1.1 Document conventions 4
1.2 Priorities 4
2 User Agent Accessibility Guidelines 6
1. Support input and output device-independence 6
2. Ensure user access to all content 10
3. Allow the user to turn off rendering or behavior that may reduce accessibility 17
4. Ensure user control over styles 19
5. Observe system conventions and standard interfaces 23
6. Implement accessible specifications 27
7. Provide navigation mechanisms 28
8. Orient the user 32
9. Notify the user of content and viewport changes 41
10. Allow configuration and customization 43
11. Provide accessible product documentation and help 51
3 Accessibility Topics 58
3.1 Access to content 58
3.2 User control of style 61
3.3 Link techniques 63
3.4 List techniques 64
3.5 Table techniques 65
3.6 Frame techniques 72
3.7 Form techniques 77
3.8 Script techniques 82
3.9 Abbreviations and acronyms 83
4 Appendix: Accessibility features of some operating systems . . . 84
5 Appendix: Loading assistive technologies for DOM access 88
6 Appendix: Assistive Technology Functionalities 94
7 Appendix: Glossary 97
8 Acknowledgments 104
9 References 107
10 Services 107

1 Introduction

This document complements the "User Agent Accessibility Guidelines 1.0". Although it reproduces the guidelines and checkpoints from that document, it is not a normative reference; the techniques introduced here are not required for conformance to the Guidelines. The document contains suggested implementation techniques, examples, and references to other sources of information as an aid to developers seeking to implement the Authoring Tool Accessibility Guidelines. These techniques are not necessarily the only way of satisfying the checkpoint, nor are they necessarily a definitive set of requirements for satisfying a checkpoint. It is expected to be updated in response to queries raised by implementors of the Guidelines, for example to cover new technologies. Suggestions for additional techniques are welcome and should be sent to the Working Group mailing list at w3c-wai-ua@w3.org. The archive of that list at http://lists.w3.org/Archives/Public/w3c-wai-ua is also available.

"User Agent Accessibility Guidelines 1.0" is part of a series of accessibility guidelines published by the Web Accessibility Initiative (WAI) . The series also includes "Web Content Accessibility Guidelines 1.0" [WAI-WEBCONTENT] and "Authoring Tool Accessibility Guidelines 1.0" [WAI-AUTOOLS] .

1.1 Document conventions

The following editorial conventions are used throughout this document:

- HTML element names are in uppercase letters (e.g., H1, BLOCKQUOTE, TABLE, etc.)
- HTML attribute names are quoted in lowercase letters (e.g., "alt", "title", "class", etc.)

1.2 Priorities

Each checkpoint in this document is assigned a priority that indicates its importance for users with disabilities.

[Priority 1]
: This checkpoint **must** be satisfied by user agents, otherwise one or more groups of users with disabilities will find it impossible to access the Web. Satisfying this checkpoint is a basic requirement for enabling some people to access the Web.

[Priority 2]
: This checkpoint **should** be satisfied by user agents, otherwise one or more groups of users with disabilities will find it difficult to access the Web. Satisfying this checkpoint will remove significant barriers to Web access for some people.

[Priority 3]
: This checkpoint **may** be satisfied by user agents to make it easier for one or more groups of users with disabilities to access information. Satisfying this

checkpoint will improve access to the Web for some people.

2 User Agent Accessibility Guidelines

This section lists each checkpoint of the Guidelines along with some possible techniques for satisfying it. Each checkpoint also links to larger accessibility topics where appropriate.

Guideline 1. Support input and output device-independence

Checkpoints for user interface accessibility:

1.1 Ensure that every functionality available through the user interface is also available through every input device API supported by the user agent. Excluded from this requirement are functionalities that are part of the input device API itself (e.g., text input for the keyboard API, pointer motion for the pointer API, etc.) [Priority 1]

Note. The device-independence required by this checkpoint applies to functionalities described by the other checkpoints in this document (e.g., installation, documentation, user agent user interface configuration, etc.). This checkpoint does not require user agents to use all operating system input device APIs , only to make the software accessible through those they do use.

Techniques:

Operating system and application frameworks provide standard mechanisms for controlling application navigation for standard input devices. In the case of Windows, OS/2, the X Windows System, and MacOS, the window manger provides GUI applications with this information through the messaging queue. In the case of non-GUI applications, the compiler run-time libraries provide standard mechanisms for receiving keyboard input in the case of desktop operating systems. Should you use an application framework such as the Microsoft Foundation Classes, the framework used must support the same standard input mechanisms.

When implementing custom GUI controls do so using the standard input mechanisms defined above. Examples of not using the standard input devices are:

- communicating directly with the device. For instance, in Windows, do not open the keyboard device driver directly. This may circumvent system messaging. It is often the case that the windowing system needs to change the form and method for processing standard input mechanisms for proper application coexistence within the user interface framework.
- implementing your own input queue handler. Devices for mobility access, such as those that use serial keys, use standard system facilities for simulating keyboard and mouse input to all graphical applications. Example facilities for generating these input device events are the Journal Playback Hooks in both OS/2 and Windows. These hooks feed the standard system message queues in these respective windowing systems. To the application, the resulting keyboard and mouse input messages are

treated as standard input and output device messages generated by the user's actions. If you implement an interface where the user selects text then issues a command related to it (e.g., select text then create a link using the selected text as content), all operations related to the selection and operation on the selected text must be done in a device-independent manner. In the case of a desktop user agent this means that the user must be able to perform these tasks using either keyboard or mouse.

- Ensure that focus may be set in a device-independent manner.
- Ensure that software may be installed, uninstalled, and updated in a device-independent manner.
- Ensure that software may be configured in a a device-independent manner.

1.2 Use the standard input and output device APIs of the operating system. [Priority 1]

For example, do not bypass standard APIs to manipulate the memory associated with rendered content, since screen review utilities monitor rendering through the APIs .

Techniques:

- When writing textual information in a GUI operating system, use standard text drawing APIs of an operating system. Text converted to offscreen images or sequences of strokes cannot be intercepted as text drawing calls at the graphics engine or display driver subsystem of a GUI. Legacy screen reading solutions intercept these drawing calls before being transferred to the display and use the text drawn to create a text model representation of what you see on the screen. This "offscreen model" is used to speak GUI text. If you do not use the standard text drawing APIs, legacy screen reading systems will not be able to render it as speech or Braille. More information on this is provided in the techniques for checkpoint 1.5.
- Use operating system resources for rendering audio information. In operating systems like Windows, a set of standard audio sound resources are provided to support standard sounds such as alerts. These preset sounds are used to activate SoundSentry visual queues when a problem occurs; this benefits users with hearing disabilities. These queues may be manifested by flashing the desktop, active caption bar, or active window. It is important to use the standard mechanisms to generate audio feedback so that operating system or special assistive technologies can add additional functionality for the hearing disabled.
- Enhance the functionality of standard system controls to improve accessibility where none is provided by responding to standard keyboard input mechanisms. For example provide keyboard navigation to menus and dialog box controls in the Apple Macintosh operating system. Another example is the Java Foundation Classes, where internal frames do not provide a keyboard mechanisms to give them focus. In this case you will need to add keyboard activation through the standard keyboard activation facility for Abstract Window Toolkit components.

- Use standard operating system resources for rendering audio information. When doing so, do not take exclusive control of system audio resources. This could prevent an assistive technology such as screen reader from speaking if they use software text-to-speech conversion.

1.3 Ensure that the user can interact with all active elements in a device-independent manner. [Priority 1]

For example, users who are blind or have physical disabilities must be able to activate text links, the links in a client-side image map, and form controls without a pointing device. **Note.** This checkpoint is an important special case of checkpoint 1.1.

Techniques:

Refer to checkpoint 1.1 and checkpoint 1.5.

Users must be able to activate text links, form controls, image maps, and other active elements with mouse or keyboard or whatever input device is supported.

For client-side image maps:

- Render client-side image maps as text links on user demand.
- If a text equivalent (specified via "alt" or "title" in HTML) is available and not null for the element (like INPUT or IMG in HTML) that has an associated client-side map, indicate the presence of a map in text (e.g., "Start of map") plus the text equivalent and the number of areas in the map. If the text equivalent is null, do not render the map or its areas.
- For each AREA in the map, if a text equivalent ("alt" or "title") is available and not null, render the text equivalent as a link. Otherwise, render some text like "Map area" plus part or all of the href value as a link. If alt "text" is null for an AREA, do not render that AREA.
- In SMIL, image maps may be created with "anchor" elements using the "href" attribute for the link. Refer to "Accessibility Features of SMIL" [SMIL-ACCESS] for details.
- When reading through the whole Web page, read the start of the map's text equivalent with the number of areas, but skip over the AREA links. To read and activate the map areas, use keys that read and navigate link by link or element by element.

Use the document object model to enable device independent activation of elements:

- When implementing Document Object Model specifications ([DOM1] , [DOM2]), allow programmatic activation of active elements, whether they are links, links in an image map, or any DOM element that can respond to an event causing a secondary action.
- In the "Document Object Model (DOM) Level 2 Specification" [DOM2] , all elements can be potentially active and it is helpful to allow for activation of all DOM elements by an assistive technology. For example, a DOM2

'focusin' event may result in the construction of a pull-down menu by an attached JavaScript function. Providing a programmatic mechanism of activating the 'focusin' function will allow users to operate the user agent through speech. Each DOM element may have more than one set of activation mechanisms based on the DOM event received and it is helpful to enable an assistive technology to enumerate those functions by description and to activate them. An example of this type of functionality can be seen in the Java Accessibility API [JAVAAPI] . This API provides an an AccessibleAction Java interface. This interface provides a list of actions and descriptions that can be used to describe and activate each function selectively.

1.4 Ensure that every functionality offered through the user interface is available through the standard keyboard API . [Priority 1]

Note. This checkpoint is an important special case of checkpoint 1.1. The comment about low-level functionalities in checkpoint 1.1 applies to this checkpoint as well. Refer also to checkpoint 10.7.

Techniques:

- Ensure that the user can trigger mouseover, mouseout, click, etc. events from the keyboard.
- Ensure that the user can use the keyboard (e.g., to navigate links sequentially).
- Ensure that the user can use the graphical user interface menus from the keyboard.
- Ensure that the keyboard can be used to cut, copy, paste, and drag.
- Ensure that the user can select text using the keyboard standards for the platform.
- Allow the user to change the state of form controls using the keyboard.

1.5 Ensure that all messages to the user (e.g., informational messages, warnings, errors, etc.) are available through all output device APIs used by the user agent. Do not bypass the standard output APIs when rendering information (e.g., for reasons of speed, efficiency, etc.). [Priority 1]

For instance, ensure that information about how much content has been viewed is available through output device APIs. Proportional navigation bars may provide this information graphically , but the information must be available (e.g., as text) to users relying on synthesized speech or Braille output.

Techniques:

Operating system and application frameworks provide standard mechanisms for using standard output devices. In the case of common desktop operating systems such as Windows, OS/2, and MacOS, standard API are provided for writing to the display and the multimedia subsystems.

It is important to also support standard output notification of sound such as notifications found in the Windows control panel for sounds. Windows maps accessibility features to the event caused by generation of these specific system sounds. Accessibility features such as SoundSentry will flash the screen, as appropriate, in response to events that would cause these sounds to play. This enables users with hearing disabilities to use the application.

When implementing standard output:

- Do not render text in the form of a bitmap before transferring to the screen. Screen Readers intercept text drawing calls to create a text representation of the screen, called an offscreen model, which is read to the user. Common operating system 2D graphics engines and drawing libraries provide functions for drawing text to the screen. Examples of this are the Graphics Device Interface (GDI) for Windows, Graphics Programming Interface (GPI) for OS/2, and for the X Windows System or Motif it is the X library (XLIB).
- Do not provide your own mechanism for generating pre-defined system sounds.
- When using a device do not use the device driver directly. In the case of display drivers, screen readers are designed to monitor what is drawn on the screen by hooking drawing calls at different points in the of the drawing process. By calling the display driver directly you may be drawing to the display below the point at which a screen reader for the blind is intercepting the drawing call.
- Do not draw directly to the video frame buffer. This circumvents the interception point at which a screen reader hooks the display calls.
- Do not forget to provide a text equivalent to voiced messages. Make sure an auditory message also has a redundant visual text message. For example, a message like "You've got mail" should also be presented with icons or text.
- Do not preclude text presentation when providing auditory tutorials. Tutorials that use speech to guide a user through the operation of the user agent should also be available at the same time as graphical representations.

Guideline 2. Ensure user access to all content

Checkpoints for content accessibility:

2.1 Ensure that the user has access to all content, including alternative equivalents for content . [Priority 1]

Techniques:

- Some users benefit from simultaneous access to primary and alternative content. For instance, users with low vision may want to view images (even imperfectly) but require a text equivalent for the image; the text may be

rendered with a large font or as speech.

- Refer to the section on access to content .
- Refer to the section on link techniques .
- Refer to the section on table techniques .
- Refer to the section on frame techniques .
- Refer to the section on form techniques .
- Refer to the section on abbreviations and acronyms .
- Refer to techniques for access to alternative equivalents of content .
- Refer to techniques for missing alternative equivalents of content .

2.2 For presentations that require user interaction within a specified time interval, allow the user to control the time interval (e.g., by allowing the user to pause and restart the presentation, to slow it down, etc.). [Priority 1]

Techniques:

- Render time-dependent links instead as a static list that occupies the same screen real estate. Include (temporal) context in the list of links. For example, provide the time at which the link appeared along with a way to easily jump to that portion of the presentation.
- Provide easy-to-use controls (including both mouse and keyboard commands) to allow users to pause the presentation and advance and rewind by small and large time increments.
- Allow the user to navigate sequences of related links that vary over time.
- Provide a mode in which all active elements are highlighted in some way and can be navigated sequentially. For example, use a status bar to indicate the presence of active elements and allow the user to navigate among them with the keyboard or mouse to identify each element when the presentation is moving and when it is paused.
- Allow the user to to stop and start the flow of changes to content. Prompt the user for confirmation of a pending change.

2.3 When no text equivalent has been supplied for an object, make available to the user and programmatically author-supplied information to help identify the object (e.g., object type, file name, etc.). [Priority 2]

Techniques:

Refer to techniques for missing alternative equivalents of content .

2.4 When a text equivalent for content is explicitly empty (i.e., an empty string), render nothing. [Priority 3]

Checkpoints for user interface accessibility:

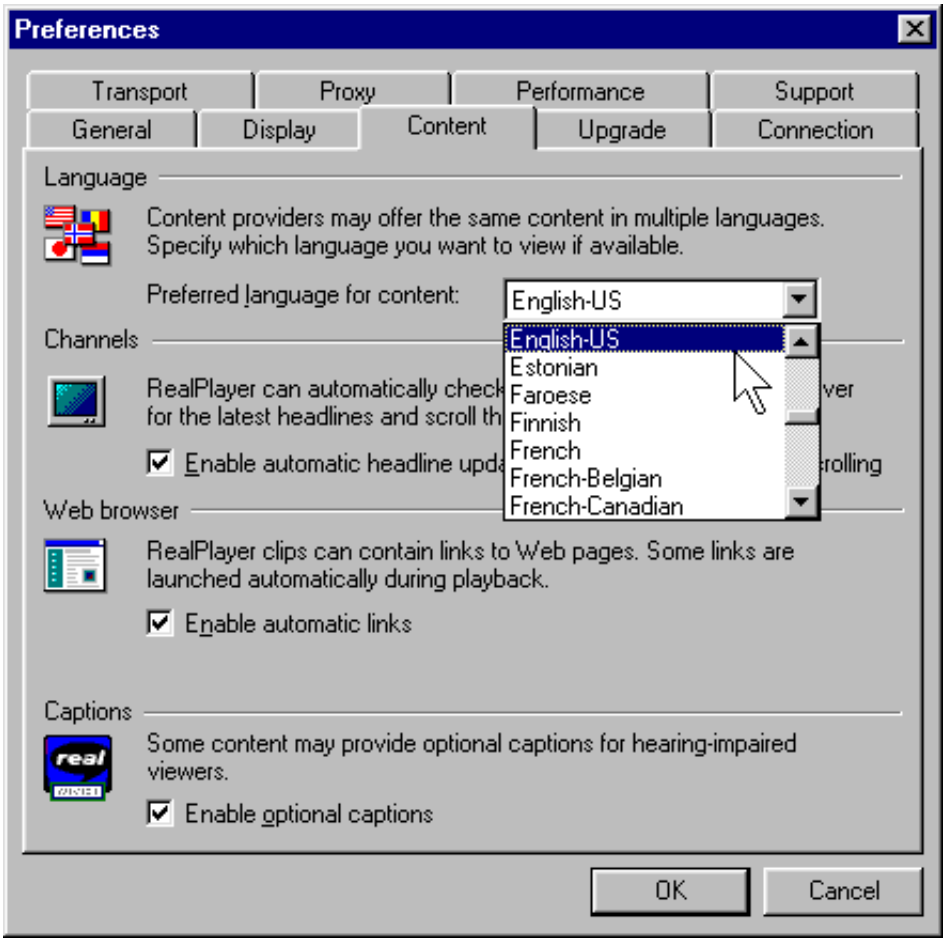
2.5 If more than one alternative equivalent is available for content, allow the user to choose from among the alternatives. This includes the choice of viewing no alternatives. [Priority 1]

For example, if a multimedia presentation has several captions (or subtitles) available (e.g., with different levels of detail, for different reading levels, in different languages, etc.) allow the user to choose from among them.

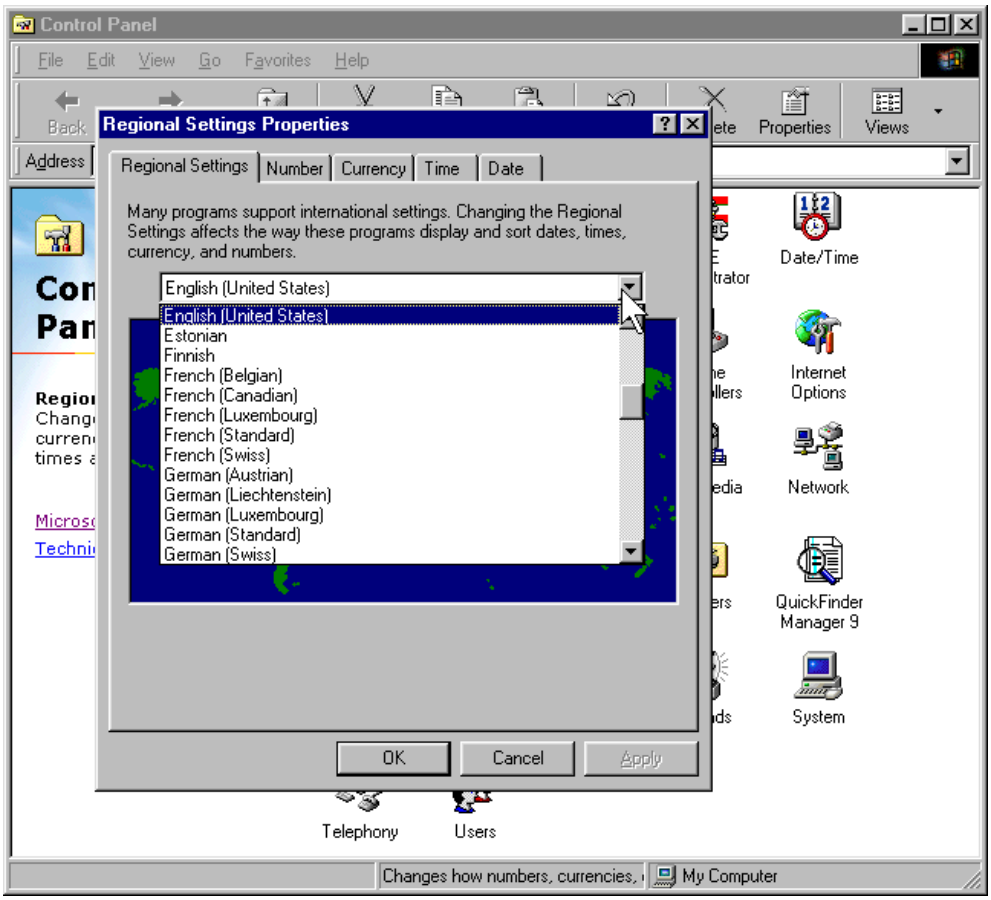
Techniques:

- Allow users to choose more than one equivalent. For instance, users may wish to have captions in different languages for multilingual audiences. Users may wish to use both captions and auditory descriptions simultaneously as well.
- Distinguish image links from their long descriptions ("longdesc" in HTML).
- Allow users to received long description text, according to their preference:
  1. always
  2. on request, with a brief signal should indicate its presence (e.g. a tone)
  3. on request, but without even that signal.
- Make information available with different levels of detail. For example, for a voice-activated browser, offer two options for alternative equivalents to HTML images:
  1. Speak only "alt" text by default, but allow the user to hear "longdesc" text on an image by image basis.
  2. Speak "alt" text and "longdesc" for all images.
- Make apparent through the user agent user interface which auditory tracks are meant to be played mutually exclusively.
- Provide an interface which displays all available tracks, with as much identifying information as the author has provided, and allow users to choose which tracks are rendered. For example, if the author has provided "alt" or "title" for various tracks, use that information to construct the list of tracks.
- Provide an interface which allows users to indicate their preferred language separately for each kind of equivalent. The selection can be based on user preferences in either the user agent (cf., the Content-Language entity-header field of RFC 2616 [RFC2616] , section 14.12) or the operating system. Users with disabilities may need to choose the language they are most familiar with in order to understand a presentation which may not include all equivalent tracks in all desired languages. In addition, international users may prefer to hear the program audio in its original language while reading captions in their first language, fulfilling the function of subtitles or to improve foreign language comprehension. In classrooms, teachers may wish to control the language of various multimedia elements to achieve specific educational goals.

  The following image illustrates how users select preferred language for captions in the Real Player.



The next image illustrates how users select preferred language in the Windows operating system under properties for Regional Settings. This preference could be inherited by the user agent.



2.6 Allow the user to specify that text transcripts , captions , and auditory descriptions be rendered at the same time as the associated auditory and visual tracks. [Priority 1]

Note. Respect synchronization cues during rendering.

Techniques:

It is important that captions and auditory descriptions be rendered synchronously with the primary content. This ensures that users with disabilities can use the primary and equivalent content in combination. For example, if a hard-of- hearing user is watching a video and reading captions, it is important for the captions to be synchronized with the audio so that the individual can use any residual hearing. For audio description, it is crucial that the primary auditory track and the auditory description track be kept in sync to avoid having them both play at once, which would reduce the clarity of the presentation.
User agents that play SMIL ([SMIL]) presentations should take advantage of a variety of access features defined in SMIL (refer to "Accessibility Features of SMIL" [SMIL-ACCESS]). A future version of SMIL (known currently as SMIL "Boston") is in development and additional access features may be available when this specification becomes a W3C Recommendation.

As defined in SMIL 1.0, SMIL players should allow users to turn captions on and off by implementing the test attribute system-captions which takes the values "on" and "off." For example, include in the player preferences a way for users to indicate that they wish to view captions, when available. SMIL files with captions available should use the following syntax:

```
<textstream alt="English captions for My Favorite Movie"
            system-captions="on"
            src="closed-caps.txt"/>
```

In this case, when the user has requested captions, this textstream should be rendered, and when they have not it should not be rendered.

SMIL 1.0 does not provide a test attribute to control auditory descriptions. However, future versions of SMIL (including SMIL "Boston") are expected to include such a test attribute. Should SMIL "Boston" become a W3C Recommendation, developers should implement it then. A test attribute to turn auditory descriptions on and off should be implemented in parallel to the implementation of the ’system-captions’ attribute. Users should be able to indicate a preference for receiving available auditory descriptions through the standard preferences setting section of the user agent user interface .

Another test attribute, ’system-overdub-or-captions’ in SMIL 1.0, allows the user to choose between alternate language text or sound. This attribute specifies whether subtitles or overdub should be rendered for people who are watching a presentation where the audio may be in a language they do not understand fluently. This attribute can have two values: "overdub", which selects for substitution of one voice track for another, and "subtitle", which means that the user prefers the display of subtitles. However, this attribute should not be used to determine if users need captions. When both are available, deaf users will prefer to view captions, which contain additional information on music, sound effects, and who is speaking, which are not included in subtitles since those are intended for hearing people.

User agents that play **QuickTime** movies should provide the user with a way to turn on and off the different tracks embedded in the movie. Authors may use these alternate tracks to provide alternative equivalents for use by people with disabilities. The Apple QuickTime player currently provides this feature through the menu item "Enable Tracks."

User agents that play **Microsoft Windows Media Object** presentations should provide support for Synchronized Accessible Media Interchange (SAMI), a protocol for creating and displaying caption text synchronized with a multimedia presentation. Users should be given a way to indicate their preference for viewing captions. In addition, user agents which play Microsoft Windows Media Object presentations should enable people to turn on and off other alternative equivalents, including auditory description and alternate visual tracks.

Other video or animation formats should incorporate similar features. At a minimum, users who are blind and users who are deaf need to be able to turn on and off auditory description and and captions. The interface to set these preferences must be accessible. Information on how to author accessible tracks

should be included in documentation about the media player.

2.7 For author-identified but unsupported natural languages, allow the user to request notification of language changes in content. [Priority 3]

Techniques:

A user agent should treat content language as part of contextual information. When the language changes, the user agent should either render the content in the supported language or notify the user of the language change (if configured for notification). Rendering could involve speaking in the designated language in the case of an audio browser or screen reader. If the language was not supported, the language change notification could be spoken in the default language by a screen reader or audio browser.

Language switching for blocks of content may be more helpful than inline language switching. In some language combinations, less than a few words long foreign phrases are often well-integrated in the primary language (e.g., Japanese being the primary and English being the secondary or quoted). In such situations, dynamic switching in in-line level may make the reading sound unnatural, and possibly harder to be understood.

Language information for HTML ("lang", "dir") and the Extensible Markup Language (XML) ("xml:lang") should be made available through the Document Object Model (DOM) ([DOM1] , [DOM2]).

User agents may announce language changes using style sheets to generate text (refer to CSS 2 [CSS2] and XSLT [XSLT]) that indicates the change of language. For instance, the user might choose to hear "language:German" when the language changes to German and "language:default" when it changes back. This may be implemented in CSS 2 with the ':before' and ':after' pseudo-elements ([CSS2] , section 5.12.3)

For example, with the following definition in the stylesheet:

```
[lang|=es]:before { content: "start Spanish "; }
[lang|=es]:after { content: " end Spanish"; }
```

the following HTML example:

```
<P lang="es" class="Spanish">
 <A href="foo_esp.html"
    hreflang="es">Esta pagina en español</A></P>
```

might be spoken "start Spanish _Esta pagina en espanol_ end Spanish". Refer also to information on matching attributes and attribute values useful for language matching in CSS 2 ([CSS2] , section 5.8.1).

If users don't want to see or hear blocks of content in another language, allow the user to suggest hiding that content (e.g., with style sheets).

- Implement content negotiation so that users may specify language preferences. Or allow the user to choose a resource when several are

available in different languages.

- Use an appropriate glyph set when rendering visually.
- Use an appropriate voice set when rendering as speech.
- Render characters with the appropriate directionality. Refer to the "dir" attribute and the BDO element in HTML 4.0 ([HTML40] , sections 8.2 and 8.2.4 respectively). Refer also to the Unicode standard [UNICODE] .
- A user agent may not be able to render all characters in a document meaningfully, for instance, because the user agent lacks a suitable font, a character has a value that may not be expressed in the user agent's internal character encoding, etc. In this case, section 5.4 of HTML 4.0 [HTML40] recommends the following for undisplayable characters:
  1. Adopt a clearly visible (or audible), but unobtrusive mechanism to alert the user of missing resources.
  2. If missing characters are presented using their numeric representation, use the hexadecimal (not decimal) form since this is the form used in character set standards.
- Refer to "Character Model for the World Wide Web" [CHARMOD] , which defines various aspects of a character model for the World Wide Web. It contains basic definitions and models, specifications to be used by other specifications or directly by implementations, and explanatory material. In particular, early uniform normalization, string identity matching, string indexing, and conventions for URIs are addressed.
- For information on language codes, refer to [ISO639] .

Guideline 3. Allow the user to turn off rendering or behavior that may reduce accessibility

In addition to the techniques below, refer also to the section on user control of style .

Checkpoints for content accessibility:

3.1 Allow the user to turn on and off rendering of background images. [Priority 1]

Techniques:

- Allow the user to turn off embedded or background images through the user agent user interface . Note that any alternative equivalents for those images must still be available.
- In CSS background images may be turned on/off with the 'background' and 'background-image' properties ([CSS2] , section 14.2.1).

3.2 Allow the user to turn on and off rendering of background audio. [Priority 1]

Techniques:

- Allow the user to turn off background audio through the user agent user interface .
- Authors sometimes specify background sounds with the "bgsound" attribute. **Note.** This attribute is **not** part of HTML 4.0 [HTML40] .
- In CSS 2, background sounds may be turned on/off with the 'play-during' property ([CSS2] , section 19.6).

3.3 Allow the user to turn on and off rendering of video. [Priority 1]

Techniques:

- Allow the user to turn off video through the user agent user interface . Render a still image in its place.
- Support the 'display' property in CSS.

3.4 Allow the user to turn on and off rendering of audio. [Priority 1]

Techniques:

- Allow the user to turn off audio through the user agent user interface .
- Support the CSS 2 'display', 'play-during', and 'speak' properties in ([CSS2] , sections 9.2.5, 19.6, and 19.5, respectively).

3.5 Allow the user to turn on and off animated or blinking text. [Priority 1]

Techniques:

- Allow the user to turn off animated or blinking text through the user agent user interface (e.g., by hitting the ESCAPE key to stop animations). Render static text in place of blinking text.
- The BLINK element. **Note.** The BLINK element is not defined by a W3C specification.
- The MARQUEE element. **Note.** The MARQUEE element is not defined by a W3C specification.
- The CSS 'blink' value of the 'text-decoration' property.

3.6 Allow the user to turn on and off animations and blinking images. [Priority 1]

Techniques:

- Allow the user to turn off animated or blinking text through the user agent user interface (e.g., by hitting the ESCAPE key to stop animations). Render a still image in its place.

3.7 Allow the user to turn on and off support for scripts and applets. [Priority 1]
Note. This is particularly important for scripts that cause the screen to flicker, since people with photosensitive epilepsy can have seizures triggered by

flickering or flashing, particularly in the 4 to 59 flashes per second (Hertz) range.

Techniques:

Peak sensitivity to flickering or flashing occurs at 20 Hertz.
Refer to the section on script techniques

3.8 Allow the user to turn on and off rendering of images. [Priority 3]

Techniques:

- Provide a simple command that allows users to toggle on and off the rendering of images on a page. This will be useful to users who wish to switch between viewing the images and the corresponding text equivalents.
- Refer to techniques for checkpoint 3.1.

3.9 For automatic content changes specified by the author (e.g., content refresh and page forwards), allow the user to slow the rate of change. [Priority 3]

For example, alert the users to content refresh, and allow them to specify a refresh rate For example, allow the user to slow content refresh to once per 10 minutes. Or, allow the user to stop automatic refresh, but indicate that content needs refreshing and allow the user to refresh the content by activating a button or link.

Techniques:

Content refresh according to an author-specified time interval can be achieved with the following markup in HTML:

```
<META http-equiv="refresh" content="60">
```

The user agent should allow the user to slow (e.g., by configuring the rate of change in seconds) or disable this type of content refresh.

Although no HTML specification defines this behavior formally, some user agents support the use of the META element to refresh the current page after a specified number of seconds, with the option of replacing it by a different URI. Instead of this markup, authors should use server-side redirects (with HTTP).

User agents can provide a link to other content rather than changing the content automatically.

User agents may also prompt the user and ask whether to continue with forwards.

Guideline 4. Ensure user control over styles

In addition to the techniques below, refer also to the section on user control of style .

Checkpoints for fonts and colors:

4.1 Allow the user to control the size of text. [Priority 1]

For example, allow the user to specify a font family and style directly through the user agent user interface . Or, allow the user to give preferences through a user style sheet. Or allow the user to magnify text.

Techniques:

- Inherit text size information from user's settings for the operating system.
- Use system features for magnification/shrinking.
- Implement the CSS 'font-size' property.
- Allow the user to configure the user agent to ignore author-specified font size.
- Allow the user to scale text while retaining relative sizes among text of different sizes.

4.2 Allow the user to control font family. [Priority 1]

Techniques:

- Implement the CSS 'font-family' property.
- Allow the user to override the author's specified fonts.
- Inherit font information from user's settings for the operating system.

4.3 Allow the user to control foreground color. [Priority 1]

Techniques:

- Implement the CSS 'color' and 'border-color' properties.
- Allow the user to specify minimal contrast between foreground and background colors, adjusting colors dynamically to meet those requirements.
- Allow the user to impose a specific foreground color, ignoring author-supplied colors.
- Inherit foreground color information from user's settings for the operating system.

4.4 Allow the user to control background color. [Priority 1]

Techniques:

- Implement the CSS 'background-color' property and other background properties.
- Allow the user to impose a specific background color, ignoring author-supplied colors.
- Inherit background color information from user's settings for the operating system.

Checkpoints for multimedia.

4.5 Allow the user to slow the presentation rate of audio, video, and animations. [Priority 1]

Techniques:

Typically, video, animation, and audio are intended to provide information to the user at a rate that allows comfortable processing of the information for the typical user. However, for some users, this rate may be too fast to allow the information to be processed, which makes it inaccessible to the user. Such users may include individuals with specific learning disabilities, cognitive deficits, or those with normal cognition but newly acquired sensory limitations (such as the person who is newly blind, learning to use a screen reader). The same difficulty is common among individuals who have beginning familiarity with a language.

For these individuals, the ability to slow the rate of presentation of information to match the individual's processing speed can make that information accessible. Since simply slowing the rate of transmission of an audio track will introduce pitch distortion that may likewise render the information inaccessible, a user agent providing rate control should also provide pitch compensation to compensate for different playback speeds.

Note. User agents may not be able to slow the playback rate for some formats. There are techniques to slow audio without leading to distortion.

4.6 Allow the user to start, stop, pause, advance, and rewind audio, video, and animations. [Priority 1]

Techniques:

- Allow the user to advance or rewind the presentation in small increments. This is particularly valuable to users with physical disabilities who may not have fine control over advance and rewind functionalities. Allow users to configure the size of the increments.
- Let the advance/rewind distances be proportional to the time you activate the corresponding button.
- Home Page Reader lets you insert slowdowns in the middle of a presentation to let you know where you are.
- Implement an acceleration feature: the longer you hold, the faster the advance and rewind.
- There are well-known techniques for changing audio speed without introducing distortion.

4.7 Allow the user to control the audio volume. [Priority 2]
4.8 Allow the user to control the position of captions on graphical displays. [Priority 1]

Checkpoints for synthesized speech:

4.9 Allow the user to control synthesized speech playback rate. [Priority 1]

Techniques:

- In CSS2, use the 'speech-rate' property.

4.10 Allow the user to control synthesized speech volume. [Priority 1]
4.11 Allow the user to control synthesized speech pitch, gender, and other articulation characteristics. [Priority 2]

Checkpoints for user interface accessibility:

4.12 Allow the user to select from available author and user style sheets or ignore them. [Priority 1]

Note. The browser's default style sheet is always present but may be overridden.

Techniques:

- Make available "class" and "id" information so that users can override styles.
- Allow the user to define custom styles for "class" and "id" attributes specified in the document.

4.13 Allow the user to control how the selection is highlighted (e.g., foreground and background color). [Priority 1]

Techniques:

- For instance, in X Windows, the following resources controls the selection colors in Netscape Navigator: "*selectForeground" and "*selectBackground".
- Implement the CSS 2 "HighLightText and "Highlight" predefined color values ([CSS2] , section 18.2).
- Inherit content focus information from user's settings for the operating system.

4.14 Allow the user to control how the content focus is highlighted (e.g., foreground and background color). [Priority 1]
4.15 Allow the user to control user agent initiated spawned viewports . [Priority 2]

For instance, allow the user to cancel viewport creation or prevent focus changes when a viewport is created. Refer also to checkpoint 9.1.

Techniques:

User agents may:

- In HTML [HTML40] , allow the user to control the process of opening a document in a new "target" frame or a viewport created by author-supplied scripts.
- In SMIL [SMIL] , allow the user to control viewports created with the "new" value of the "show" attribute.
- Allow users to turn off support for spawned viewports entirely
- Prompt them before spawning a viewport. For instance, for user agents that support CSS2 [CSS2] , the following rule will generate a message to the user at the beginning of link text for links that are meant to open new windows when followed:

```
A[target=_new]:before{content:"Open new window"}
```

- Users may also want to control the size or position of the viewport and to be able to close the viewport (e.g., with the "back" functionality).

For example, user agents may recognize the HTML construct `target="_blank"` and spawn the window according to the user's preference.

Allow the user to configure how current focus changes when a new viewport is spawned. For instance:

- Never change the current focus.
- Always change the current focus and use a discrete alert (e.g., a flash or beep) to indicate that the current focus has changed.

Guideline 5. Observe system conventions and standard interfaces

Checkpoints for content accessibility:

5.1 Provide programmatic read and write access to content by conforming to W3C Document Object Model (DOM) specifications and exporting interfaces defined by those specifications. [Priority 1]

For example, refer to DOM Levels 1 and 2 ([DOM1] , [DOM2]). User agents should export these interfaces using available operating system conventions.

Techniques:

A Document Object Model (DOM) is an interface to a standardized tree structure representation of a document. This interface allows authors to access and modify the document with client-side scripting language (e.g., JavaScript) in a consistent manner across scripting languages. As a standard interface, a DOM makes it easier not just for authors but for assistive technology developers to extract information and render it in ways most suited to the needs of particular users. Information of particular importance to accessibility that must be available through the DOM includes:

- Content, including alternative equivalents .

- Style sheet information (for user control of styles).
- Script and event handlers (for device-independent control of behavior).
- The document structure (for navigation, creation of alternative views).

User agents should implement W3C DOM Recommendations, including DOM Level 1 [DOM1] and DOM Level 2 [DOM2]]. The W3C Recommendation for DOM Level 1 ([DOM1]) provides access to HTML and XML document information. The DOM Level 2 ([DOM2]) is made of a set of core interfaces to create and manipulate the structure and contents of a document and a set of optional modules. These modules contain specialized interfaces dedicated to XML, HTML, an abstract view, generic stylesheets, Cascading Style Sheets, Events, traversing the document structure, and a Range object.

It is important to note that DOM is designed to be used on a server as well as a client and therefore a lot of user interface-specific information such as screen coordinate information is not relevant and not addressed by the DOM specification.

Assistive technologies also require information about browser highlight mechanisms (e.g., the selection and focus) that may not be available through the W3C DOM.

The DOM Level 1 specification states that "DOM applications may provide additional interfaces and objects not found in this specification and still be considered DOM compliant."

Note. *The WAI Protocols and Formats Working Group is focusing its efforts on the DOM as the conduit from which to extract accessibility information and enhance the accessibility of a rendered document through a user agent.*

Checkpoints for user interface accessibility:

5.2 Provide programmatic read and write access to user agent user interface controls using standard APIs (e.g., platform-independent APIs such as the W3C DOM, standard APIs for the operating system, and conventions for programming languages, plug-ins, virtual machine environments, etc.) [Priority 1]

For example, ensure that assistive technologies have access to information about the current input configuration so that they can trigger functionalities through keyboard events, mouse events, etc.

Techniques:

The operating system APIs that support accessibility are designed to provide a bridge between the standard user interface supported by the operating system and alternative user interfaces developed by third-party assistive technology vendors to provide access to persons with disabilities. Applications supporting these APIs are therefore generally more compatible with third-party assistive technology.

The User Agent Accessibility Guidelines Working Group strongly recommends using and supporting APIs that improve accessibility and compatibility with third-party assistive technology. Third-party assistive technology can use the accessibility information provided by the APIs to provide an alternative user interface for various disabilities.

The following is an informative list of currently public APIs that promote accessibility:

- Microsoft Active Accessibility ([MSAA]) in Windows 95/98/NT versions.
- Sun Microsystems Java Accessibility API ([JAVAAPI]) in Java Code. If the user agent supports Java applets and provides a Java Virtual Machine to run them, the user agent should support the proper loading and operation of a Java native assistive technology. This assistive technology can provide access to the applet as defined by Java accessibility standards.

Thus, developers should use the platform's standard user interface components whenever possible and ensure that custom components provide equivalent accessibility information as standard user interface components in the same programmatic way. For other user interface components not based on a platform's standard toolkit, provide information and events equivalent to that found in currently available accessibility APIs (e.g., JAAPI and MSAA).

Many operating systems have built-in accessibility features for improving the usability of the standard operating system by persons with disabilities. When designing software that runs above an underlying operating system, developers should ensure that the application:

1. Makes use of operating system level features. See the appendix of accessibility features for some common operating systems.
2. Inherits operating system settings related to accessibility. Pertinent settings include font and color information and other information described in this document.

Write output to and take input from standard system APIs rather than directly from hardware controls where possible. This will enable the I/O to be redirected from or to assistive technology devices - for example, screen readers and Braille devices often redirect output (or copy it) to a serial port, while many devices provide character input, or mimic mouse functionality. The use of generic APIs makes this feasible in a way that allows for interoperability of the assistive technology with a range of applications.

User agents should use standard rather than custom controls when designing user agents. Third-party assistive technology developers are more likely able to access standard controls than custom controls. If you must use custom controls, review them for accessibility and compatibility with third-party assistive technology.

For information about rapid access to Microsoft Internet Explorer's DOM through COM, refer to [BHO] .

5.3 Implement selection , content focus , and user interface focus mechanisms and make them available to users and through APIs . [Priority 1]

Refer also to checkpoint 7.1 and checkpoint 5.2. **Note.** This checkpoint is an important special case of checkpoint 5.2.

5.4 Provide programmatic notification of changes to content and user interface controls (including selection , content focus , and user interface focus). [Priority 1]

Refer also to checkpoint 5.2.

5.5 Ensure that programmatic exchanges proceed in a timely manner. [Priority 2]

This is important for synchronization of alternative renderings and simulation of events.

5.6 Follow operating system conventions and accessibility settings. In particular, follow conventions for user interface design, default keyboard configuration, product installation, and documentation . [Priority 2]

Refer also to checkpoint 10.2.

Techniques:

Develop the user interface with standard components per the target platform(s). Most major operating system platforms provide a series of design and usability guidelines; these should be followed when possible (see platforms below). These checklists, style guides, and human interface guidelines provide very valuable information for developing applications (e.g., UAs) for any platform/operating system/GUI.

For instance, software should use the standard interface for keyboard events rather than working around it.

Evaluate your standard interface components on the target platform against any built in operating system accessibility functions (see Appendix 8) and be sure your UA operates properly with all these functions.

For example, take caution with the following:

- Microsoft Windows supports an accessibility function called "High Contrast". Standard window classes and controls automatically support this setting. However, applications created with custom classes or controls must understand how to work with the "GetSysColor" API to ensure compatibility with High Contrast.
- Apple Macintosh supports an accessibility function called "Sticky Keys". Sticky Keys operates with keys the operating system recognizes as modifier keys, and therefore a custom UA control should not attempt to define a new modifier key.
- Respect default input configurations for the operating system. For example, the default configuration should not include "Alt-F4" or "Control-Alt-Delete" on operating systems where that combination has special meaning to the operating system.

Some guidelines for specific platforms:

- "Macintosh Human Interface Guidelines" [APPLE-HI] Apple Computer Inc.
- "IBM Guidelines for Writing Accessible Applications Using 100% Pure Java" [JAVA-ACCESS] .
- "An ICE Rendezvous Mechanism for X Window System Clients" [ICE-RAP] .
- "Information for Developers About Microsoft Active Accessibility" [MSAA] .
- "The Inter-Client communication conventions manual" [ICCCM] .
- "Lotus Notes accessibility guidelines" [NOTES-ACCESS] .
- "Java accessibility guidelines and checklist" [JAVA-CHECKLIST] .
- "The Java Tutorial. Trail: Creating a GUI with JFC/Swing" [JAVA-TUT] .
- "The Microsoft Windows Guidelines for Accessible Software Design" [MS-SOFTWARE] .

General guidelines for producing accessible software:

- "Accessibility for applications designers" [MS-ENABLE] .
- "Application Software Design Guidelines" [TRACE-REF] .
- "Designing for Accessibility" [SUN-DESIGN] .
- "EITAAC Desktop Software standards" [EITAAC] .
- "Requirements for Accessible Software Design" [ED-DEPT] .
- "Software Accessibility" [IBM-ACCESS] .
- Towards Accessible Human-Computer Interaction" [SUN-HCI] .
- "What is Accessible Software" [WHAT-IS] .
- Accessibility guidelines for Unix and X Window applications [XGUIDELINES] .

Follow System Conventions for loading Assistive Technologies:

User agents should follow operating system or application environment (e.g., Java) conventions for loading assistive technologies. In the case of Java applets, the browser's Java Virtual Machine should follow the Sun convention for loading an assistive technology. Writing an application that follows the Java system conventions for accessible software does not allow the applet to be accessible if an assistive technology designed for that environment cannot be run to make the applet accessible. Refer to the appendix on loading assistive technologies for DOM access for information about how an assistive technology developer can load its software into a Java Virtual Machine.

Guideline 6. Implement accessible specifications

Checkpoints for content accessibility:

6.1 Implement the accessibility features of supported specifications (markup languages, style sheet languages, metadata languages, graphics formats, etc.). [Priority 1]

Note. The Techniques Document [UA-TECHNIQUES] addresses the accessibility features of W3C specifications.

Techniques:

- Features that are known to promote accessibility should be made obvious to users and easy to find.
- The accessibility features of Cascading Style Sheets ([CSS1] , [CSS2]) are described in "Accessibility Features of CSS" [CSS-ACCESS] . Note that CSS 2 includes properties for controlling synthesized speech styles.
- The accessibility features of SMIL 1.0 [SMIL] are described in "Accessibility Features of SMIL" [SMIL-ACCESS] .
- The following is a list of accessibility features of HTML 4.0 [HTML40] in addition to those described in techniques for checkpoint 2.1:
  - The CAPTION element (section 11.2.2) for rich table captions.
  - Table elements (THEAD, TBODY, TFOOT (section 11.2.3), COLGROUP, and COL (section 11.2.4) that group table rows and columns into meaningful sections.
  - Attributes ("scope", "headers", and "axis", section 11.2.6) that non-visual browsers may use to render a table in a linear fashion, based on the semantically significant labels.
  - The "tabindex" attribute (section 17.11.1) for assigning the order of keyboard navigation within a document.
  - The "accesskey" attribute (section 17.11.2) for assigning keyboard commands to active components such as links and form controls.

6.2 Conform to W3C specifications when they are appropriate for a task. [Priority 2]
For instance, for markup, implement HTML 4.0 [HTML40] or XML 1.0 [XML] . For style sheets, implement CSS ([CSS1] , [CSS2]). For mathematics, implement MathML [MATHML] . For synchronized multimedia, implement SMIL 1.0 [SMIL] . For access to the structure of HTML or XML documents, implement the DOM ([DOM1] , [DOM2]). Refer also to checkpoint 5.1.
Note. For reasons of backward compatibility, user agents should continue to support deprecated features of specifications. The current guidelines refer to some deprecated language features that do not necessarily promote accessibility but are widely deployed.

Guideline 7. Provide navigation mechanisms

Checkpoints for user interface accessibility:

7.1 Allow the user to navigate viewports (including frames). [Priority 1]
Note. For example, when all frames of a frameset are displayed side-by-side, allow the user to navigate among them with the keyboard. Or, when frames are accessed or viewed one at a time (e.g., by a text browser or speech synthesizer), provide a list of links to other frames. Navigating into a viewport makes it the current viewport .

Techniques:

- Some operating systems provide a means to navigate among all open windows using multiple input devices (e.g., keyboard and mouse). This technique would suffice for switching among user agent viewports that are separate windows. However, user agents may also provide a mechanism to shift the user interface focus among user agent windows, independent of the standard operating system mechanism.
- Consult the section on frame techniques .

7.2 For user agents that offer a browsing history mechanism, when the user returns to a previous viewport, restore the point of regard in the viewport . [Priority 1]

For example, when users navigate "back" and "forth" among viewports, they should find the viewport position where they last left it.

7.3 Allow the user to navigate all active elements . [Priority 1]

Navigation may include non-active elements in addition to active elements.
Note. This checkpoint is an important special case of checkpoint 7.6.

Techniques:

2.7.1 Sequential navigation techniques

Allow the user to sequential navigate all active elements using a single keystroke. User agents might also provide other sequential navigation mechanisms for particular element types or semantic unit. For example "Find the next table" or "Find the previous form".

It is important that application developers maintain a logical element navigation order. For instance, users may use the keyboard to navigate among elements or element groups and using the arrow keys within a group of elements. One example of a group of elements is a set of radio buttons. Users should be able to navigate to the group of buttons, then be able to select each button in the group. Similarly, allow users to navigate from table to table, but also among the cells within a given table (up, down, left, right, etc.)

- How to indicate that something is in navigation order in Java: A component is inclusive in the sequential navigation order when added to a panel and its isFocusTraversable() method returns true. A component can be removed from the navigation order by simply extending the component, overloading this method, and returning false.
- Give the users the option of navigating to *and activating* a link, or just moving the content focus to the link. When the user returns to the page after following the link, restore content focus to that link.
- Many user agents today allow users to navigate sequentially by repeating a key combination -- for example, using the "tab" key for forward navigation and "shift-tab" for reverse navigation. Because the "tab" key is typically on one side of the keyboard while arrow keys are located on the other, users should be allowed to configure the user agent so that sequential navigation is possible with keys that are physically closer to the arrow keys. Refer also

to checkpoint 10.4.

- The default sequential navigation order should respect the conventions of the natural language of the document. Thus, for most left-to-right languages, the usual navigation order is top-to-bottom and left-to-right. Thus, for right-to-left languages, the order would be top-to-bottom and right-to-left.

2.7.2 Direct navigation techniques

Excessive use of sequential navigation can reduce the usability of software for both disabled and non-disabled users. Direct navigation (e.g., through keyboard shortcuts) should also be possible. Providing direct navigation involves:

- Assigning each active element a unique identifier (or use the identifier provided by the author, e.g., "accesskey" in HTML). For example number each active element in a document.
- Documenting how the user may access elements.
- Allowing direct navigation by element content (e.g., the first letter of element content).
- Allowing direct navigation to a table cell by its row/column position.
- Allow searching (e.g., based on form control text, associated labels, or form control names).

7.4 Allow the user to choose to navigate only active elements . [Priority 2]

Techniques:

Refer to techniques for checkpoint 7.3.

7.5 Allow the user to search for rendered text content, including rendered text equivalents . [Priority 2]

Note. Use operating system conventions for marking the result of a search (e.g., selection or content focus).

Techniques:

- Allow users to search for element content and attribute values (human-readable ones).
- Allow forward and backward searching from the point of regard, beginning of document, or end of document.
- Allow users to search the document source view.
- For forms, allow users to find required controls. Allow users to search on labels as well as content of some controls.
- Allow the user to search among just text equivalents of other content.
- For multimedia presentations:
  - Allow users to search and examine time-dependent media elements and links in a time-independent manner. For example, present a static list of time-dependent links.

- Allow users to find all media elements active at a particular time in the presentation.
- Allow users to view a list of all media elements or links of the presentations sorted by start or end time or alphabetically.
- For frames, allow users to search for content in all frames (without having to be in a particular frame).

7.6 Allow the user to navigate according to structure. [Priority 2]
For example, allow the user to navigate familiar elements of a document: paragraphs, tables and table cells, headers, lists, etc. **Note.** Use operating system conventions to indicate navigation progress (e.g., selection or content focus).

Techniques:

- DOM is minimal (tree navigation)
- Best navigation will involve a mix of source tree information and rendered information.
- May use commonly understood document models rather than strict Document Type Definition (DTD) navigation. E.g., properly nesting headers in HTML. Headers should be used only to convey hierarchy, not for graphical side-effects.
- Allow the user limit navigation to the cells of a table (notably left and right within a row and up and down within a column). Navigation techniques include keyboard navigation from cell to cell (e.g., using the arrow keys) and page up/down scrolling. Refer to the section on table navigation .
- Goal of simplifying the structure view as much as possible.
- Allow the user to control level of detail/ view of structure.
- Depth first as well as breadth first possible. Allow next/previous sibling, up to parent, and end of element.
- Navigation of synchronized multimedia: allow users to stop, pause, fast forward, advance to the next clip, etc.
- Allow the user to navigate characters, words, sentences, paragraphs, screenfuls, and other language-dependent pieces of text content. This may be particularly useful with a speech-based user interface. Precise and flexible navigation of this kind with a system cursor is often useful when browsing with accessibility aids. Evidence of this point is that the leading Windows screen readers have super-imposed such navigation on a popular web browser that does not natively support it (e.g., Winvision, Window-Eyes, and JAWS with Internet Explorer).

Skipping navigation bars:

Author-supplied navigation mechanisms such as navigation bars at the top of each page may force users with screen readers or some physical disabilities to wade through numerous links on each page of a site. User agents may facilitate browsing for these users by allowing them to skip recognized navigation bars

(e.g., through a configuration option). Some techniques for doing so include:

1. Provide a functionality to jump to the first non-link content.
2. In HTML, the MAP element may be used to mark up a navigation bar (even when there is no associated image). Thus, users might ask that MAP elements not be rendered in order to hide links inside the MAP element. **Note.** Starting in HTML 4.0, the MAP element allows block content, not just AREA elements.

7.7 Allow the user to configure structured navigation. [Priority 3]

For example, allow the user to navigate only paragraphs, or only headers and paragraphs, etc.

Techniques:

- Allow the user to navigate by element type.
- Allow the user to navigate HTML elements that share the same "class" attribute.
- Allow the user to expand or shrink portions of the structured view (control detail level) for faster access to important parts content.

Guideline 8. Orient the user

Checkpoints for content accessibility:

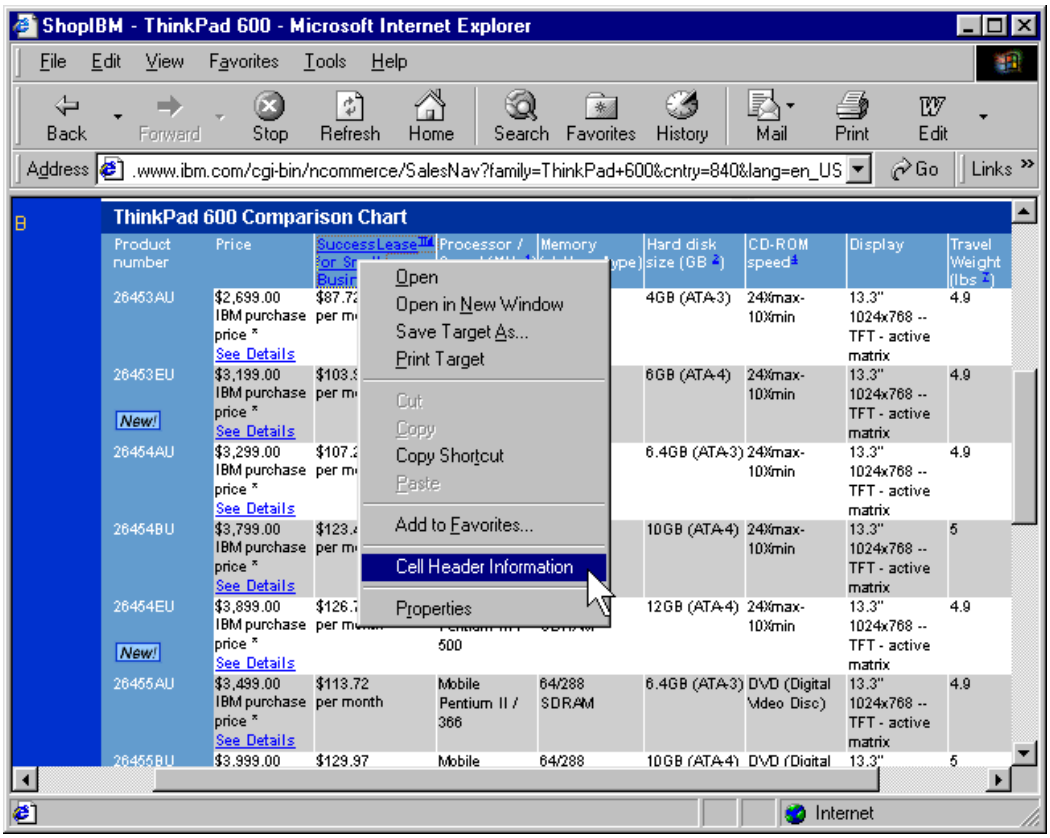
8.1 Make available to the user the author-specified purpose of each table and the relationships among the table cells and headers. [Priority 1]

For example, provide information about table headers, how headers relate to cells, table summary information, cell position information, table dimensions, etc. Refer also to checkpoint 5.1. **Note.** This checkpoint is an important special case of checkpoint 2.1.

Techniques:

- Refer to the section on table techniques
- Allow the user to access this information on demand (e.g., by activating a menu or keystroke).

The following illustration shows how Internet Explorer provides cell header information through the context menu:



8.2 Indicate to the user whether a link has been visited. [Priority 2]

Note. This checkpoint is an important special case of checkpoint 8.4.

Techniques:

- Do not rely on color alone.
- Refer to the section on link techniques .

8.3 Indicate to the user whether a link has been marked up to indicate that following it will involve a fee. [Priority 2]

Note. This checkpoint is an important special case of checkpoint 8.4. "Common Markup for micropayment per-fee-links" [MICROPAYMENT] describes how authors may mark up micropayment information in an interoperable manner. This information may be provided through the standard user interface provided the interface is accessible. Thus, any prompt asking the user to confirm payment must be accessible.

Techniques:

- For a link that has content focus , allow the user to query the link for fee information.
- Refer to the section on link techniques .
- Allow the user to access this information on demand (e.g., by activating a

menu or keystroke for a link).

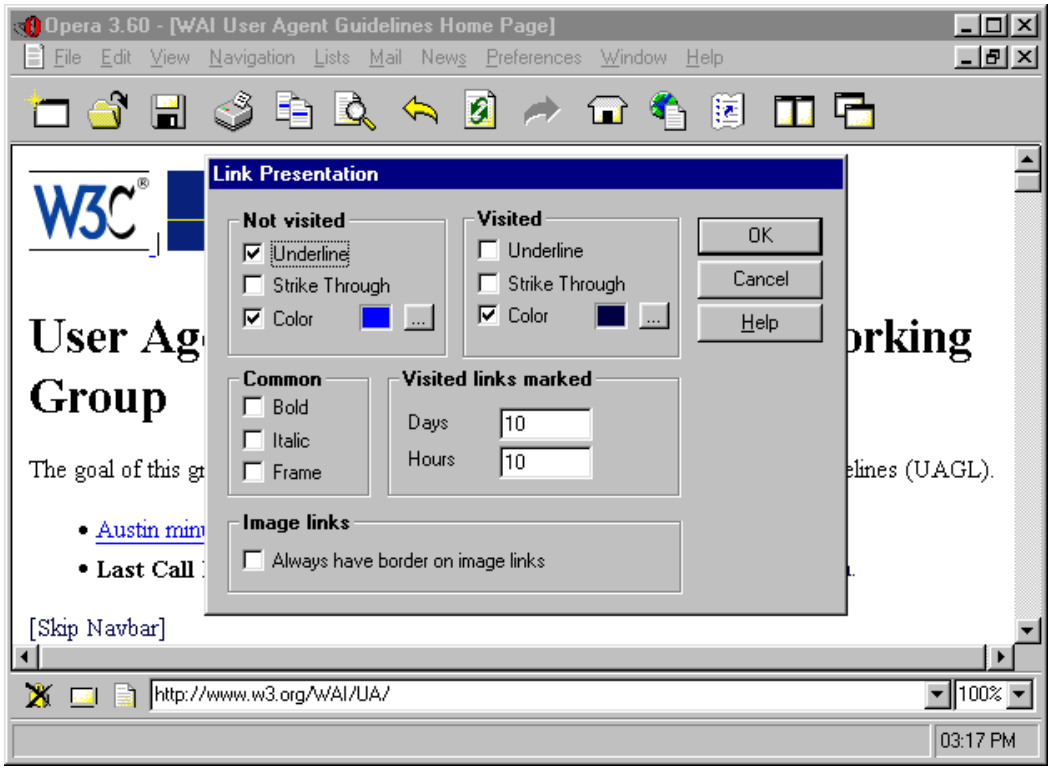
8.4 Make available to the user information that will help the user decide whether to follow a link. [Priority 3]

Note. Useful information includes: whether the link designates an internal or external anchor, the type of the target resource, the length and size of an audio or video clip that will be started, and the expected natural language of target resource.

Techniques:

- For a link that has content focus , allow the user to query the link for information.
- Refer to the section on link techniques .
- Allow the user to access this information on demand (e.g., by activating a menu or keystroke).
- Implement CSS ':visited' and ':link' pseudo-classes, with ':before' class and the 'content' property to insert text before a link such as "visited" or "un-visited".

The following image shows how the Opera browser allows the user to configure how links are rendered, including controlling the rendering of visited and un-visited links.



Checkpoints for user interface accessibility:

8.5 Provide a mechanism for highlighting and identifying (through a standard interface where available) the current viewport , selection , and content focus . [Priority 1]

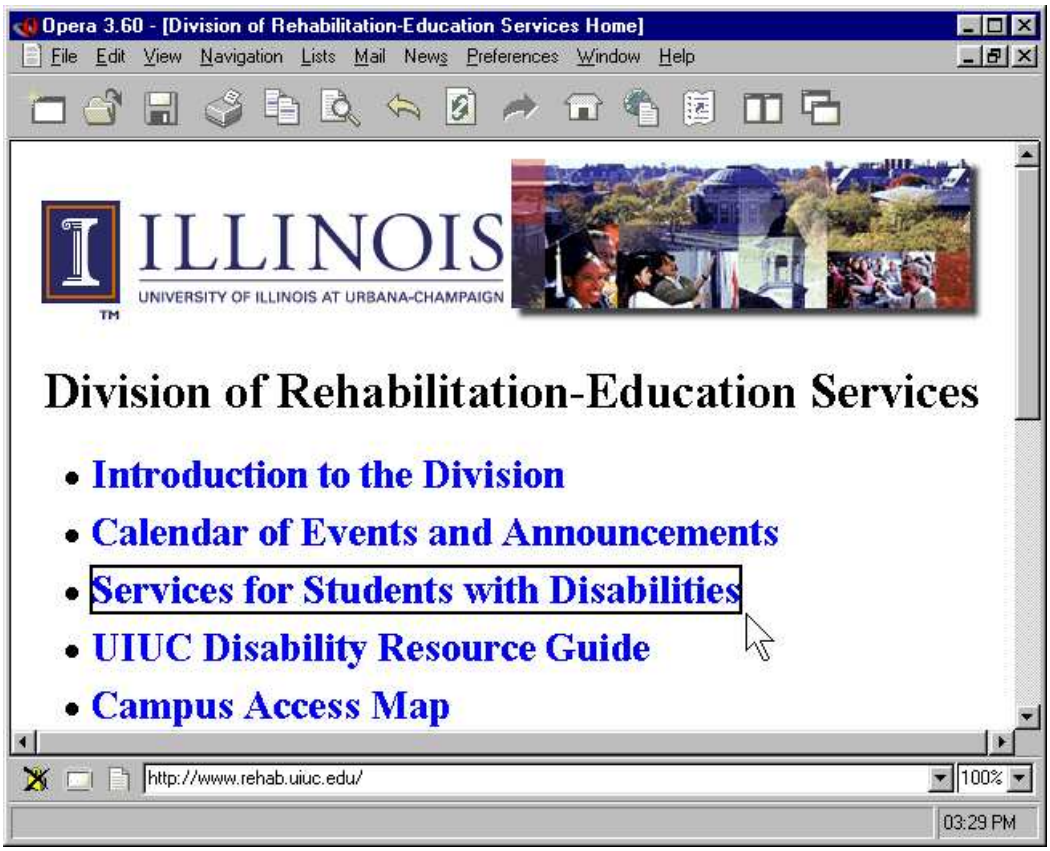
Note. This includes highlighting and identifying frames. **Note.** This checkpoint is an important special case of checkpoint 1.1. Refer also to checkpoint 8.4.

Techniques:

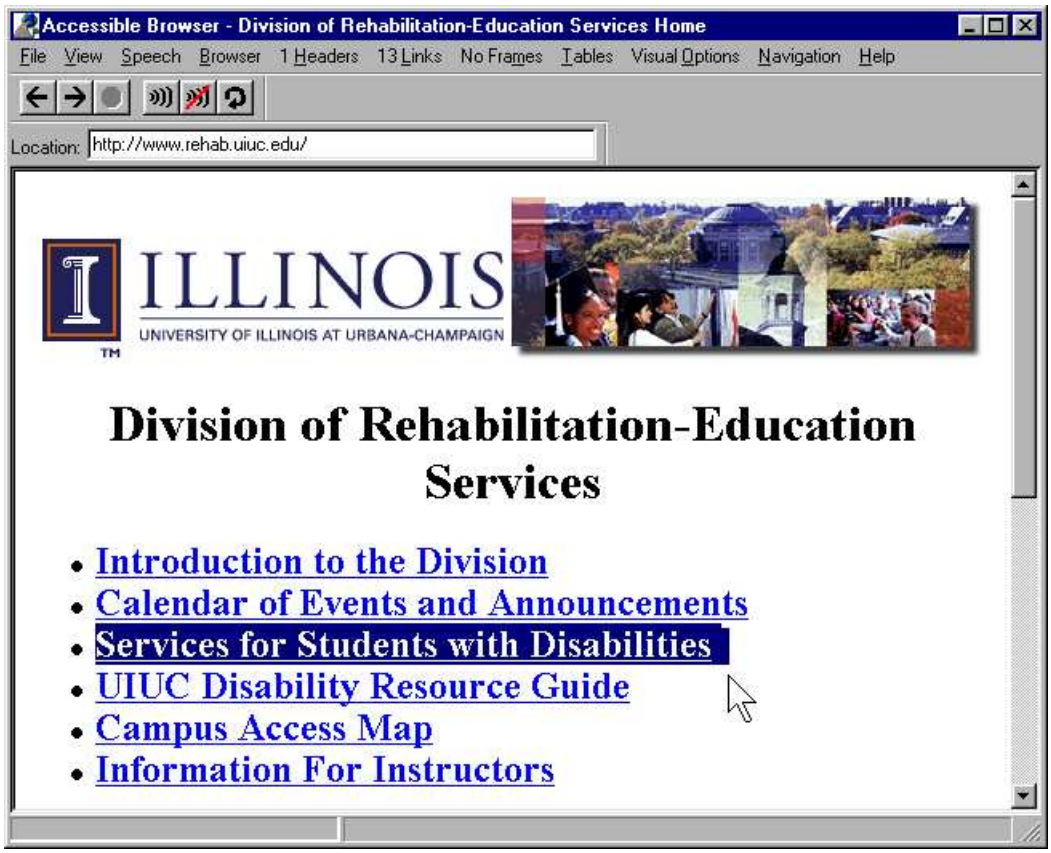
- If colors are used to highlight the current viewport, selection, or content focus, allow the user to set preferred colors and to ensure sufficient contrasts.
- If the current viewport is a window, allow the user to cause the window to pop to the foreground.
- If the current viewport is a frame or the user doesn't want windows to pop to the foreground, use colors, reverse videos, or other visual clues to indicate the current viewport. For speech or Braille output, render the title or name of a frame or window and indicate changes in the current viewport.
- Use operating system conventions, where available, for specifying selection and content focus (e.g., schemes in Windows).
- Implement the CSS pseudo-classes ':hover', ':active', and ':focus'. This will allow users to modify content focus presentation with user style sheets.

Refer also to the section on frame techniques

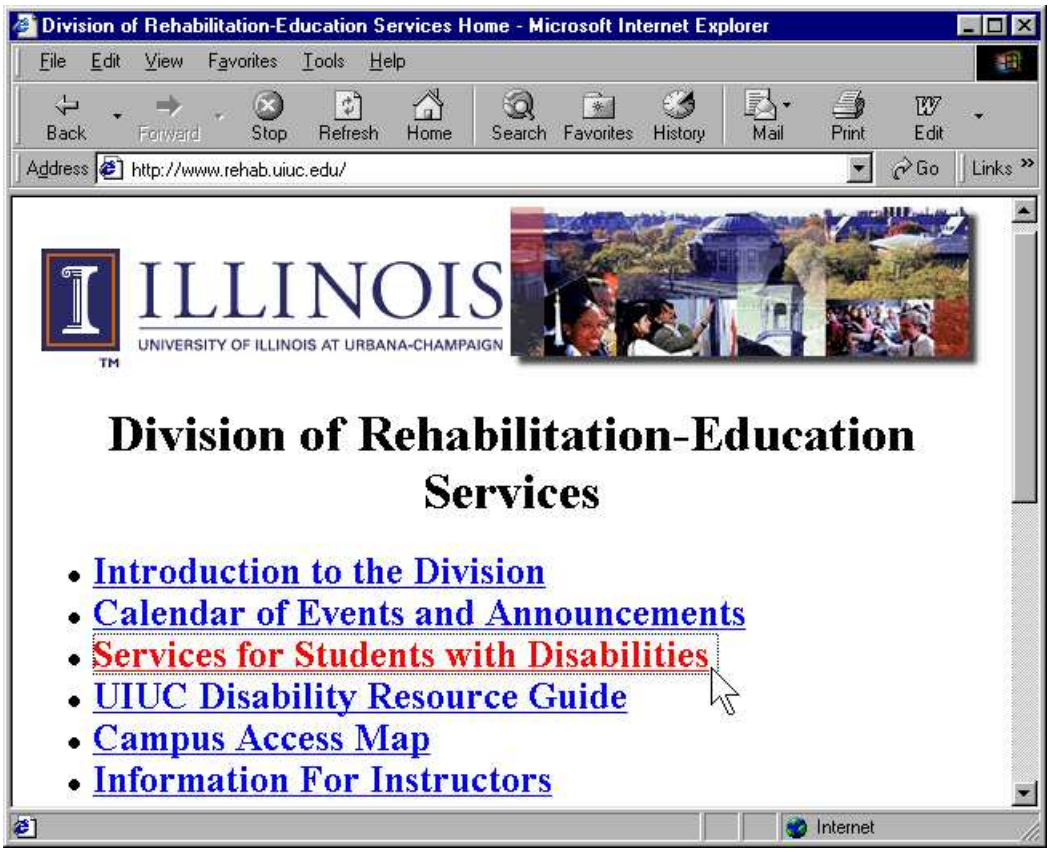
The following image illustrates the use by Opera 3.6 of a solid line border to indicate content focus:



The following image illustrates the use of system highlight colors to indicate content focus:



The following image illustrates the use of a dotted line border to indicate content focus:



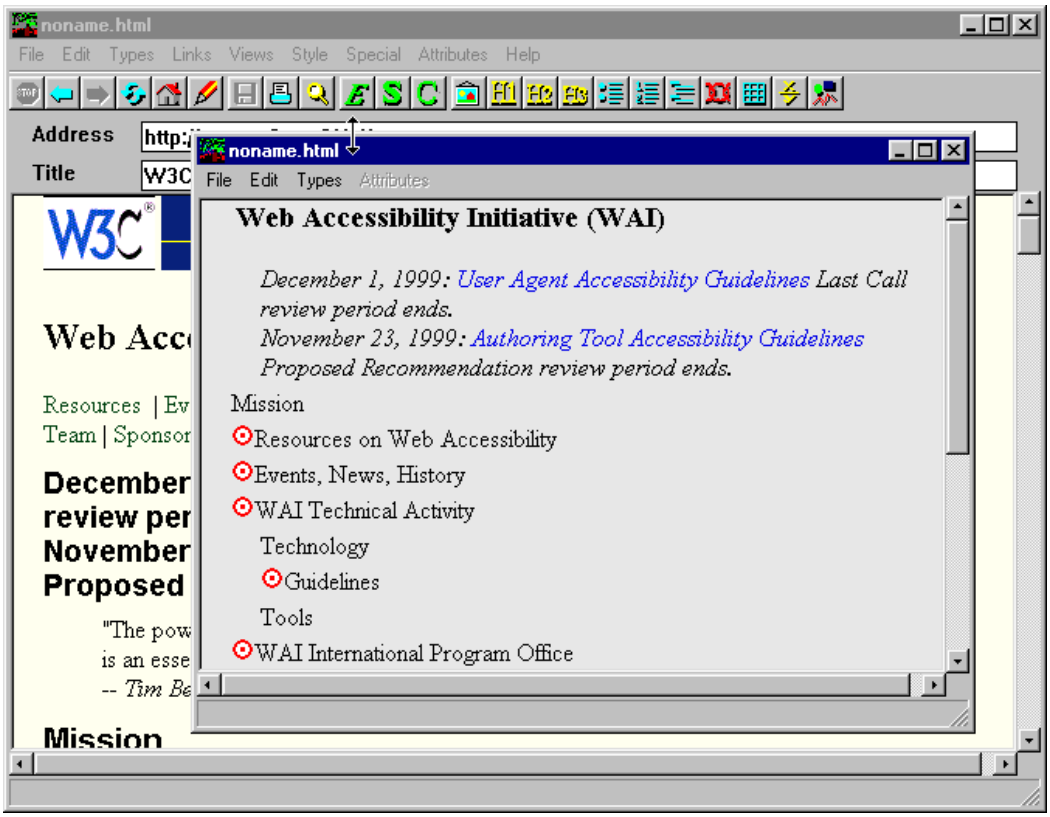
8.6 Make available to the user an "outline" view of content, built from structural elements (e.g., frames, headers, lists, forms, tables, etc.) [Priority 2]

For example, for each frame in a frameset, provide a table of contents composed of headers where each entry in the table of contents links to the header in the document. **Note.** The outline view doesn't have to be navigable, but if it is, it may satisfy checkpoint 7.6.

Techniques:

- Use commonly understood document models rather than strict DTD navigation. E.g., properly nesting headers in HTML.
- For documents that don't use structure properly, user agents may try to create an outline from presentation elements used (insufficiently) to convey structure.
- Allow the user to shrink and expand the outline view selectively.
- Provide context-sensitive navigation: for instance, when the user navigates to a list or table, provide locally useful navigation mechanisms (e.g., within a table, cell-by-cell navigation) using similar input commands.
- Refer to the section on list techniques .
- Implement a structured view by hiding portions of the document tree by using the CSS 'display' and 'visibility' properties ([CSS2] , sections 9.2.5 and 11.2, respectively).

The following image shows the table of contents view provided by Amaya. The table of contents view provided by Amaya can be navigated and the primary graphical view is synchronized with the table of contents view, so that the element with the focus in the table of contents is always in the graphical view.



The following technique ideas were provided by the National Information Standards Organization [NISO] :

A "Navigation Control Center" (NCC) (NCC) resembles a traditional table of contents, but it is more. The NCC contains links to all headings at all levels in the book. In addition to the headings, links to all pages are inserted. Finally we include in the NCC links to all items that the reader may select to turn off for reading. For example, if the reader has the automatic reading of footnotes turned off, there must be a way to quickly get back to that information. For this reason, the reference to the footnote is placed in the NCC and the reader can go to the reference, understand the context for the footnote, and then read the footnote. All items that have the option of turning off automatic reading can be reached through the NCC.

Once the reader is at a desired location and wishes to begin reading, the navigation process changes. Of course, the reader may elect to read sequentially, but often some navigation is required (e.g., frequently people navigate forward or backward one word or character at a time). Moving

from one sentence or paragraph at a time is also needed. This type of local navigation is different from the global navigation used to get to the location of what you want to read. It is frequently desirable to move from one block element to the next. For example, moving from a paragraph to the next block element which may be a list, blockquote, or sidebar is the normally expected mechanism for local navigation.

8.7 Provide a mechanism for highlighting and identifying active elements (through a standard interface where available). [Priority 2]

Note. User agents may satisfy this checkpoint by implementing the appropriate style sheet mechanisms, such as link highlighting.

Techniques:

- Do not rely on color alone to identify active elements.
- Use CSS selectors to associate style with elements. In particular:
  - Use CSS link pseudo-classes to highlight links (:link, :active, :hover).
  - Use CSS attribute selectors to match elements with associated scripts.
- Allow users to configure highlighting preferences.

8.8 Allow the user to configure the outline view. [Priority 3]

For example, allow the user to control the level of detail of the outline. Refer also to checkpoint 8.6. Refer also to checkpoint 5.2.

Techniques:

For implementations using the CSS 'display' and 'visibility' properties ([CSS2] , sections 9.2.5 and 11.2, respectively), allow the user to override the default settings in user style sheets.

Example.

The following CSS 2 style sheet will turn the display off of all HTML elements inside the BODY element except header elements:

```
<STYLE type="text/css">
   BODY * { display: none }
   H1, H2, H3, H4, H5, H6 { display: block }
</STYLE>
```

Another approach would be to use class selectors to identify those elements to hide or display.

End example.

8.9 Allow the user to configure what information about links to present. [Priority 3]

Note. Using color as the only distinguishing factor between visited and unvisited links does not suffice since color may not be perceivable by all users or rendered by all devices. Refer also to checkpoint 8.4.

Techniques:

- Allow the user to access this information on demand (e.g., by activating a menu or keystroke).
- Implement CSS ':visited' and ':link' pseudo-classes, with ':before' class and the 'content' property to insert text before a link such as "visited" or "un-visited".

Guideline 9. Notify the user of content and viewport changes

Checkpoints for user interface accessibility:

9.1 Provide information about user agent initiated content and viewport changes through the user interface and through APIs [Priority 1]

For example, inform the users when a script causes a popup menu to appear. Refer also to checkpoint 4.15.

Techniques:

- Refer to the section on frame techniques
- Render the changed content graphically .
- Highlight the current viewport.
- Emit an audible signal when a change occurs.
- Make DOM methods fire a "change" event that can be trapped.

9.2 Ensure that when the selection or content focus changes, it is in a viewport after the change. [Priority 2]

For example, users navigating links may navigate to a portion of the document outside the viewport, so the viewport should scroll to include the new location of the focus.

Techniques:

- There are time when the content focus changes (e.g., link navigation) and the viewport must be moved to track it. There are other times when the viewport changes position (e.g., scrolling) and the content focus is moved to follow it. In both cases, the focus (or selection) is in the viewport after the change.
- Make sure that search windows do not place the new content focus that is the found object under a search popup.
- When the content focus changes, "register" the newly focused element in the navigation sequence; sequential navigation should start from there.
- Only change selection/content focus in the current viewport, not other viewports.

9.3 Prompt the user to confirm any form submission triggered indirectly, that is by any means other than the user activating an explicit form submit control. [Priority 2]

For example, do not submit a form automatically when a menu option is selected, when all fields of a form have been filled out, or when a mouseover event occurs.

Techniques:

- Put up a dialog indicating the form will be submitted if it is done by an onChange, after a certain time, or for other script-based submission. Allow the user to suppress these dialogs for good.
- If the submit button is not the last control in the form, and no controls after it have been focused, put up a dialog pointing this out/asking if the user has filled in the information after the button.
- If a Javascript submission is fired, allow the user to ask for it to be intercepted and trigger the dialog mentioned above.

9.4 Allow the user to configure notification preferences for common types of content and viewport changes. [Priority 3]

For example, allow the user to choose to be notified (or not) that a script has been executed, that a new viewport has been opened, that a pulldown menu has been opened, that a new frame has received focus , etc.

Techniques:

- Refer to the section on frame techniques
- Allow the user to specify an element type for which notification should be disabled (e.g., table, body, img, ...)
- Allow the user to disable notification of changes to CSS properties
- Allow the user to disable notification of images that are changed

---

9.5 When loading content (e.g., document, video clip, audio clip, etc.) indicate what portion of the content has loaded and whether loading has stalled. [Priority 3]

Techniques:

Status information - on content loading - should be provided in a device-independent manner. Techniques include text and non-text status indicators. Users should be able to request status information or have it rendered automatically. User agents may allow users to configure when status information should be rendered (e.g., by hiding or showing the status bar).

Screen readers may provide access on demand (e.g., through the keyboard) to the most recent status information, or to announce the new information whenever it changes.

Useful status information:

- Document proportions (numbers of lines, pages, width, etc.)
- Number of elements of a particular type (e.g., tables)
- The viewport is at the beginning or end of the document.
- Size of document in bytes.

User agents may allow users to configure what status information they want rendered. Allow users to access status information on demand through a keyboard or other shortcut.

Indicate when loading has finished, for example with a percentage indication or a special message. Indication must not depend on a particular output device.

9.6 Indicate the relative position of the viewport in content (e.g., the percentage of an audio or video clip that has been played, the percentage of a Web page that has been viewed, etc.). [Priority 3]

Note. The user agent may calculate the percentage according to content focus position, selection position, or viewport position, depending on how the user has been browsing.

Techniques:

- Provide a scrollbar for the viewport.
- Give the size of the document as well, so that users may decide whether to download for offline viewing. For example, the playing time of an audio file could be stated in terms of hours, minutes, and seconds. The size of a primarily text based web page might be stated in both kilobytes and screens, where a screen of information is calculated based on the current dimensions of the viewport.
- List the current "page" as page X of a total of Y pages.
- Use a variable pitch audible signal to indicate position.
- Keep the information numerically and generate the output on user request. See new HTML work on Forms for further examples (a slider is like a dial is like a menu of lots of options...)
- Provide standard markers for specific percentages through the document (mile posts)
- Provide markers for positions relative to some position - a user selected point, the bottom, the H1, etc.
- Put a marker on the scrollbar, or a highlight at the bottom of the page while scrolling (so you can see what was the bottom before you started scrolling

---

Guideline 10. Allow configuration and customization

Checkpoints for user interface accessibility:

10.1 Provide information directly to the user and through APIs about current user preferences for input configurations (e.g., keyboard or voice bindings). [Priority 1]

Techniques:

If the currently active configuration changes locally (e.g., a search prompt opens, changing the keyboard mapping for the duration of the prompt), alert the user. The user must also be informed of the changed (currently active) configuration. Do not rely on visual or audio cues alone to alert the user of the change. Do not limit the user to only one type of alert mechanism. Do not rely on visual cues (e.g., the underlining of an accelerator key) alone to inform the user of changes in the configuration.

Named configurations are easier to remember. This is especially important for persons with certain types of cognitive disabilities. For example, if the invocation of a search prompt changes the currently active configuration, the user may remember more easily which keystrokes are active in search mode if alerted that there is a "Search Mode". Context-sensitive help (if available) should reflect the change in mode, and a list of keybindings for the current mode should be readily available to the user.

2.10.1 Documentation of sequential navigation order

- Specified by the HTML 4.0 "tabindex" attribute ([HTML40] , section 17.11.1).
- Provide a list of form controls according to the sequential navigation order of the form. This allows users to know whether, for example, a submit button is the last control in a form or whether the user must activate controls that follow it.
- Provide a structured view of form controls (e.g., those grouped by LEGEND or OPTGROUP in HTML) along with their labels.

2.10.2 Documentation of keyboard shortcuts

- Specified by the HTML 4.0 "accesskey" attribute ([HTML40] , section 17.11.2).
- Use system conventions to indicate the current configuration.
- Document the default configuration.
- Allow direct navigation to active elements (links, form controls, etc.). For instance, through a menu that allows users to enter a link number of link text and to move the content focus there.
- Allow the user to separate setting the content focus and activating the control. For links, first-time users of a page may want to hear link text before deciding whether to follow the link (activate). More experienced users of a page would prefer to follow the link directly, without the intervening content focus step.

2.10.3 Configuration of the user interface

- Allow the user to configure the user agent so that the current viewport is automatically maximized. For example, the parent window of the browser would automatically be maximized when launched, and each child window would automatically be maximized when it received focus . Maximizing does not necessarily mean occupying the whole screen or parent window; it means expanding the current window so that the need to scroll horizontally or vertically is as little as possible.

10.2 Avoid default input configurations that interfere with operating system accessibility conventions. [Priority 1]

In particular, default configurations should not interfere with the mobility access keyboard modifiers reserved for the operating system. Refer also to guideline 5.

10.3 Provide information directly to the user and through APIs about current author-specified input configurations (e.g., keyboard bindings specified in content such as by "accesskey" in HTML 4.0). [Priority 2]

Techniques:

- Make a list of keybindings for the currently rendered page available to the user. If any of the author-defined keybindings conflict with application or OS keybindings, alert the user in a device independent manner. Do not, for example, rely exclusively on font or color changes, on the playing of an audio clip, or upon an icon to convey this information to the user.
- In case of conflicts between author-supplied configuration and user-supplied, operating system defaults, or user agent default configurations, here is some possible behavior:
  1. Do not override default system and UA controls, but alert the user if author-supplied keybindings conflict with them, and provide a pass-through mechanism to allow the user to invoke author-specified UI controls that conflict with default UA or OS controls/keybindings.
  2. Allow author-defined keybindings to over-ride UA and OS keybindings, but alert the user of the conflicts, and provide a pass-through mechanism so that the conflicting UA / OS keybindings can still be invoked.
  3. Allow the user to choose to have the UA re-map author-supplied keybindings to currently unused keystrokes, then alert the user to which keystrokes the author-supplied UI controls / keybindings have been re-mapped.

It is probably useful to distinguish the following classes of user input configurations:

- What are the defaults "out of the box"?
- What are the current settings different from those out of the box.
- What are those in effect for the current document only?
- What are those that have been overridden by the configuration of the

current document? Also, how to access functionalities no longer available due to the current input configuration.

In association with local (e.g., "this page only") and off-default bindings, provide information about how to work around the override.

Note that user support personnel, particularly remote support personnel, will need the "departures from shipping defaults" view for orientation.

The above classes may be distinguished by displayed properties in a combined presentation as well as by filtering to present only a restricted class.

Some reserved keyboard shortcuts are listed in the appendix on accessibility features of some operating systems.

10.4 Allow the user to change and control the input configuration . Allow the user to configure the user agent so that some functionalities may be activated with a single command (e.g., single key, single voice command, etc.). [Priority 2]

For voice-activated browsers, allow the user to modify what voice commands activate functionalities Similarly, allow the user to modify the graphical user agent user interface for quick access to commonly used functionalities (e.g., through buttons).

Techniques:

Provide a convenient interface for allowing users to control input configurations. For example, allow them to select some pre-configured options rather than having them enter combinations themselves. This will speed up configuration and reduce questions to support staff later on how to configure the user agent.

User agents that allow users to customize or reconfigure mappings from keyboard, voice, etc. to user agent functionalities should allow each mapping to be accompanied by a description so that the user can understand the mapping. For example, if "Control-P" maps to a print functionality, a short description would be "Print" or "Print setup".

- Profiles
- Default values
- Device-independent configuration

When using a physical keyboard, some users require single-key access, others require that keys activated in combination be physically close together, while others require that they be spaced physically far apart. When allowing users to configure keyboard access to functionalities, user agents must consider operating system conventions, author-specified shortcuts, and user preferences. The user agent’s default configuration should include shortcuts for frequently performed tasks and should respect operating system conventions.

User agents, to allow the user to turn on and off author-specified keyboard configurations, may offer a checkbox in the keyboard mapping dialog to that would toggle the support for author-specified keyboard configurations. In HTML 4.0, authors may specify keyboard behavior with the "tabindex" and "accesskey" attributes ([HTML40] , sections 17.11.1 and 17.11.2, respectively).

Allow users to restore easily the user agent's default configuration.

Allow users to create macros and bind them to keystrokes or other input methods.

2.10.4 Configuration of activation method

When the author specifies a keyboard shortcut (e.g., with "accesskey" in HTML), only the shortcut key is defined. It is left to the user agent to apply a triggering mechanism that will invoke the shortcut key. For example, Microsoft Internet Explorer 5 uses the ALT key as the trigger key when running on the Windows platform. This triggering mechanism, however, conflicts with some default OS and application keybindings that also rely upon the ALT key for their triggering mechanism, such as ALT+F (the keybinding that invokes the "File" menu) and ALT+H (the keybinding that invokes the "Help" menu).

Until a W3C Recommendation or some other specification explains how to resolve conflicts, user agents may resolve them by allowing users to choose from among several triggering mechanisms for keyboard shortcuts. The user agent can ask the user to choose a shortcut trigger, and warn the user of potential conflicts (e.g., through context sensitive help, a "More Information" button, a field label, explanatory text in a .cfg file, etc.). While the interactivity level of such a mechanism is best left to individual developers to define, a basic definition request could take a form similar to the following, platform-specific, example:

> Please choose triggering mechanism for shortcut keys. Some shortcut keys are specified by authors so that you may activate a link, move through a page, or activate form controls using a keystroke combination. Half of the combination (an alphabetic or numeric character) is pre-defined by the author. In order to trigger the shortcut key, however, you must select a "trigger key", which -- when pressed in conjunction with the shortcut key -- will activate the associated element. It is highly recommended that you do not use the ALT or CONTROL keys for the trigger, as they are commonly used to trigger application and system events in the Windows environment.

This type os mechanism/message might be presented to the user the first time that a page with author-specified shortcut keys is loaded. Such a mechanism should also form part of the general configuration mechanism for the user agent.

Ensure **uniform** behavior when a shortcut key is invoked. Provide the user with the following options:

1. move focus to the element for which the shortcut key has been defined.
2. activate the element for which the shortcut key has been defined
3. prompt the user each time an shortcut key is invoked. **Note.** The prompt should also allow the user to "Save current choice as the default action for the shortcut key X")

2.10.5 Single-key configuration

To illustrate problems some users with poor motor control encounter and why single-key access is important: Put the keyboard Repeat Delay to very short and the Repeat rate to very fast (or whatever rate is bothersome). The slightest touch or accidental bump will generate a key press, illustrating the challenge key combinations pose.

In keyboard-driven browsing the page control keys just right of ENTER are important so the Web navigation keys should be around ENTER [which gets a link]. The enhanced keyboard is huge for anyone using just 1 digit, be it head or hand; and key combinations add tiring, extra work while individual keys go unused. Example: SHIFT-TAB to get the previous Anchor means 2 keystrokes which is hard as I'm unsteady (To get an idea of what how some folks work put the keyboard Repeat Delay to very short and Repeat rate to very fast, key combinations become a huge challenge, to say the least) and apt to miss the desired link so it can take 4 keystrokes to pick a link. Just as Page Up and Down are paired on the Keypad area Web navigation controls must be paired on the main keyboard (Less movement around keyboards helps folks with muscle degeneration as they tend to have slow or reduced mobility).

Opera uses the main alphanumeric key area of keyboards to make all common browser commands single-key commands. The software keyboard Mouse, "Mouse Keys" (which turns NumPad into single-key mouse commands), is a prime example of using keyboards in a different manner to give people with physical disabilities a usable command structure. Moreover "Mouse Keys" proves that such innovation doesn't interfere with expected use by users who don't need single-key configurations because it can be turned on and off, or time-out itself.

Some pairs include move Anchor highlight up and down and next page and back to previous page. Vertical or horizontal pairing might provide a cue about what movement occurs, perhaps a UI designer could comment. BACKSPACE for page back and the "=" key for page ahead. The "[" key for Anchor up and ";" key for down [this is only for links]. Form boxes should be selected via TAB and SHIFT-TAB, for limited use a key combo is fine because it actually lessens chances users get into an unwanted mode. Using O or Zero seems too confusing so lets use 9 for Previous Frame and I as Next Frame [and Anchor movements should cycle within a Frame, not the whole page]. DHTML Layers K as Up and "," as Down with U to Activate events. The 9, I, K, and "," keys are roughly in line vertically yet key rows are offset so its harder to slide up or down

then left or right, where the sides of keys fully in line making a mistaken push easier. Because Frames and Layers divide pages up it would help if browsers used sound files to say Frames and/or Layers are on a page. Moving between HTML Headings hasn't been too helpful as many Web pages are non-linear so Headings doesn't resemble Page-Down command to get to a lower sub-section, H and N will do.

10.5 Follow operating system conventions to indicate the input configuration . [Priority 2]

For example, on some operating systems, if a functionality is available from a menu, the letter of the key that will activate that functionality is underlined. **Note.** This checkpoint is an important special case of checkpoint 5.6.

Techniques:

In some operating systems, information about shortcuts is rendered visually using an underscore under a character in a menu item or button corresponding to the shortcut key activated with an ALT+character. For menu accelerators the text in the menu item is often followed by a CNTRL+function key. These are conventions used by the Sun Java Foundations Classes [JAVA-TUT] and Microsoft Foundations Classes for Windows.

10.6 Allow the user to configure the user agent through profiles . [Priority 2]

Users must be able to select from among available profiles or no profile (i.e., the user agent default settings).

Techniques:

Configuration profiles allow individual users to save their user agent settings and re-apply them easily. This is particularly valuable in an environment where several people may use the same machine. Profiles may include rendering preferences as well as user email address, proxy information, stylesheet preferences, etc.

The user should be able to easily transfer profiles between installations of the same user agent (e.g., over the network). One way to facilitate this is to follow applicable operating system conventions for profiles.

Users should be able to switch rapidly between profiles (or the default settings) and to set a new default profile. This is helpful when:

- Several people use the same machine.
- One user is being helped by another who may not recognize the information being displayed using the user's profile.

User agents may apply a profile when the user logs in. They may also allow users to apply settings interactively, for example by allowing them to choose from a list of named profiles in a menu.

Sample profiles (based on common usage scenarios) can assist users in the initial set up of the user agent. These profiles can serve as models and may be copied and fine-tuned to meet an individual's particular needs.

Cascading Style Sheets may be part of a source document or linked externally. Stand-alone style sheets are useful for implementing user profiles in public access computer environments where several people use the same computer. User profiles allow for convenient customization and may be shared by a group.

A text profile may be pasted in email and is useful for technical support purposes.

Provide compatibility modes for users who require a familiar user interface. For instance, let the user choose from a list of default input configurations from preceding versions of the software.

10.7 Provide default input configurations for frequently performed tasks. [Priority 3]
Make the most frequently operations easy to access and operable through a single command. In particular, provide convenient mappings to functionalities that promote accessibility such as navigation of links. Functionalities include being able to show, hide, resize and move graphical viewports created by the user agent.

Techniques:

- Make available different profiles .
- Test the default keyboard configuration for usability. Ask users with different disabilities and combinations of disabilities to test configurations.
- For people using one hand, a few fingers, or a headwand pointer, access to important functionalities must be available through one or at most two key presses.
- Avoid deeply nested menus.
- Allow users to accomplish tasks through repeated keystrokes (e.g., sequential navigation) since this means less physical repositioning for all users.
- However, repeated keystrokes may not be efficient for some tasks. For instance, do not require the user to position the pointing device by pressing the "down arrow" key repeatedly.
- Input configurations should allow quick and direct navigation that does not rely on graphical output. Do not require the user to navigate through "space" (through a graphical user interface) as the only way to activate a functionality.

10.8 Allow the user to configure the arrangement of graphical user agent user interface controls. [Priority 3]

Techniques:

- Allow multiple icon sizes (big, small, other sizes).
- Allow the user to choose icons and/or text
- Allow the user to change the grouping of icons
- Allow the user to change the position of control bars, icons, etc. Do not rely solely on drag-and-drop for reordering tool bar; the user must be able to configure the user agent user interface in a device-independent manner (e.g., through a text-based profile).

Guideline 11. Provide accessible product documentation and help

Checkpoints for user interface accessibility:

11.1 Provide a version of the product documentation that conforms to the Web Content Accessibility Guidelines. [Priority 1]

User agents may provide documentation in many formats, but at least one must conform to the Web Content Accessibility Guidelines [WAI-WEBCONTENT] . Alternative equivalents for content , navigation mechanisms, and illustrations will all help make the documentation accessible.

Techniques:

It is essential that any web-based support and/or documentation that is produced or maintained by the manufacturer of a user agent or by a sub-contractor of the user agent's developer, conform to the Web Content Accessibility Guidelines [WAI-WEBCONTENT] . This includes (but is not limited to):

1. text equivalents of all graphics
2. extended descriptions of screen-shots, flow-charts, etc.
3. clear and consistent navigation and search mechanisms
4. use of the NOFRAMES element when the support/documentation is presented in a FRAMESET
5. serial listings of keystrokes and keybindings

Accessing documentation in familiar applications is particularly important to users with disabilities who must learn the functionalities of their tools and be able to configure them for their needs. Commonly used applications are also more likely to be compatible with assistive technology. Electronic documentation should not be provided in proprietary formats.

Where possible, allow users to download documentation in a single block (e.g., single HTML file, zip archive of several HTML and image files, etc.)

Run-time help and any Web-based help or support information, as well as the documentation distributed with the tool, must be fully accessible to persons with disabilities. Per checkpoint 1.1, the user must be able to invoke the run-time

help with a simple, well documented keystroke command. It is strongly suggested that the keybinding used to invoke the UAs help system be the default "Help" keybinding for the operating system.

Users with print disabilities may need or desire documentation in alternative formats such as Braille (refer to "Braille Formats: Principles of Print to Braille Transcription 1997" [BRAILLEFORMATS]), large print, or audio tape. User agent manufacturers may provide user manuals in alternative formats. Documents in alternative formats can be created by agencies such as Recording for the Blind and Dyslexic and the National Braille Press.

User instructions should be expressed in an input device independent manner. Provide instructions for using or configuring the user agent in a manner that can be understood by a user of any input device including a mouse or keyboard. For example, "Select the Home button on the toolbar" or "Select Home from the Go menu to return to the Home page."

Universal design means that access to features that help accessibility should be integrated into standard menus. User agents should avoid regrouping access to accessibility features into specialized menus.

Proper documentation is important to developers with disabilities, not just users with disabilities. A disabled user may be a developer using the user agent as a test bed or someone who needs critical information that can only be obtained by as direct a path to the tool’s mechanics and "under-the-hood" features as possible. Detailed accessible documentation (e.g., distributed on CD-ROM) is important to allow assistive technology developers access to APIs , etc.

Ensure that product identification codes are accessible to users so they may install their software. Codes printed on product cases will not be accessible to people with visual disabilities.

11.2 Document all user agent features that promote accessibility. [Priority 1]
For example, review the documentation or help system to ensure that it includes information about the functionalities addressed by the checkpoints of this document.

Techniques:

Include references to accessibility features in these parts of the documentation:

1. Indexes. Include terms related to product accessibility in the documentation index (e.g., "accessibility", "disability" or "disabilities").
2. Tables of Contents. Include terms related to product accessibility in the documentation table of contents (e.g., features that promote accessibility)
3. Include instructions on how to modify all user configurable defaults and preferences (e.g, images, video, style sheets, and scripts) as specified by the documentation.

4. Include a list of all keyboard shortcuts or other input configuration information in the accessibility section of the documentation.
5. Document the features implemented to conform with these Guidelines.

Accessibility features should be presented as such, not hidden under other topics. For instance, users (especially novice users) should be able to look up "How to turn off blinking text" in the documentation. Even if the solution for turning off blinking text is to turn off scripts, users should not have to guess that turning off scripts will disable blinking text. The user interface should also be designed so that accessibility topics are presented as such.

11.3 Document the default input configuration (e.g., default keyboard bindings). [Priority 1]

Techniques:

Here is a table showing mappings between Netscape Navigator functions (or potential functions) and their keyboard shortcuts in Macintosh, Unix, and Windows versions. If a function exists in the browser but does not have a shortcut, its corresponding cell is marked with an asterisk(*). If the function does not exist, it is left blank. **Note.** This table lists some, but not all, functionalities and keyboard shortcuts of Netscape Navigator. It is meant to illustrate, not serve as definitive documentation.

Some entries contain links to special notes. The number in parentheses following the link is the number of the relevant note.

Linear version of of Netscape Navigator Keyboard Shortcuts.

Netscape Navigator Keyboard Shortcuts

Function	Macintosh (v 4.61)	Unix (v 4.51)	Windows (v 4.7)
Move within a document			
Scroll to next page	**Page Down**	**Page Down**	**Page Down**
Scroll to previous page	**Page Up**	**Page Up**	**Page Up**
Scroll to top	*	*	**Ctrl-Home**
Scroll to bottom	*	*	**Ctrl-End**
Move between documents			
Open a new document	**Command+L**	**Alt+O**	**Ctrl+O**

Stop loading a document	**Command+.**	**Esc**	**Esc**
Refresh a document	**Command+R**	**Alt+R**	**Ctrl+R**
Load previous document	**Command+[** or **Command+Left Arrow**	**Alt+Left Arrow**	**Alt+Left Arrow**
Load next document	**Command+]** or **Command+Right Arrow**	**Alt+Right Arrow**	**Alt+Right Arrow**
Navigate elements within a document			
Move focus to next frame	*	*	*
Move focus to previous frame	*	*	*
Move focus to next active element (1)	**Tab**	**Tab**	**Tab**
Move focus to previous active element (1)	**Shift+Tab**	**Shift+Tab**	**Shift+Tab**
Find word in page	**Command+F**	**Alt+F**	**Ctrl+F**
Act on HTML elements			
Select a link	*	*	**Enter**
Toggle a check box	*	*	**Shift** or **Enter**
Activate radio button	*	*	**Shift**
Move focus to next item in an option box	*	*	**Down Arrow** or **Right Arrow**

Move focus to previous item in an option box	*	*	**Up Arrow** or **Left Arrow**
Select item in an option box	*	*	**Enter**
Press a button (2)	**Return**	**Enter**	**Enter**
Navigate menus			
Activate menu	*	*	**Alt+** the underlined letter in the menu title
Deactivate menu	*	**Esc**	**Esc**
Move focus to next menu item	*	* (3)	**Down Arrow**
Move focus to previous menu item	*	* (3)	**Up Arrow**
Select menu item	*	underlined letter in the menu item	**Enter**
Move focus to submenu	*	* (3)	**Right Arrow**
Move focus to main menu	*	* (3)	**Left Arrow**
Navigate bookmarks			
View bookmarks menu	* (4)	*	**Alt+C+B**
Move focus to next item in bookmarks menu	Down Arrow (4)	*	**Down Arrow**
Move focus to previous item in bookmarks menu	Up Arrow (4)	*	**Up Arrow**
Select item in bookmarks menu	Return (4)	*	**Enter**

Add bookmark	**Command+D**	**Alt+K**	**Ctrl+D**
Edit bookmarks	**Command+B**	**Alt+B**	**Ctrl+B**
Delete current bookmark (5)	**Delete**	**Alt+D**	**Delete**
Navigate history list			
View history list	**Command+H**	**Alt+H**	**Ctrl+H**
Move focus to next item in history list	*	*	**Down Arrow**
Move focus to previous item in history list	*	*	**Up Arrow**
Move focus to first item in history list	*	*	**Left Arrow**
Select item in history list	*	*	**Enter** (6)
Close history list	**Command+W**	**Alt+W**	**Ctrl+W**
Define view			
Increase font size (7)	**Shift+Command+]**	**Alt+]**	**Ctrl+]**
Decrease font size (7)	**Shift+Command+[**	**Alt+[**	**Ctrl+[**
Change font color	*	*	*
Change background color	*	*	*
Turn off author-defined style sheets	*	*	*
Turn on user-defined style sheets (8)	?	?	?
Apply next user-defined style sheet	?	?	?

Apply previous user-defined style sheet	?	?	?
Other functionalities			
Access to documentation	*	*	*

Notes.

1. In Windows, active elements can be links, text entry boxes, buttons, checkboxes, radio buttons, etc. In Unix and Macintosh, **`Tab`** cycles through text entry boxes only.
2. In Windows, this works for any button, since any button can gain the user interface focus using keyboard commands. In Unix and Macintosh, this only applies to the "Submit" button following a text entry.
3. In Unix, the menus can not be opened with shortcut keys. However, once a menu is opened it stays opened until it is explicitly closed, which means that the menus can still be used with shortcut keys to some extent. Sometimes left and right arrows move between menus and up and down arrows move within menus, but this does not seem to work consistently, even within a single session.
4. In Macintosh, you can not explicitly view the bookmarks menu. However, if you choose "Edit Bookmarks", which does have a keyboard shortcut, you can then navigate through the bookmarks and open bookmarked documents in the current window.
5. To delete a bookmark you must first choose "Edit Bookmarks" and then move the focus to the bookmark you want to delete.
6. In Windows, when you open a link from the history menu using **`Enter`**, the document opens in a new window.
7. All three systems have menu items (and corresponding shortcut keys) meant to allow the user to change the font size. However, the menu items are consistently inactive in both Macintosh and Unix. The user seems to be able to actually change the font sizes only in Windows.
8. It is important to allow users to set their own cascading style sheets (css). Although Netscape does currently allow the user to override the author’s choice of foreground color, background color, font, and font size, it does not allow some of the advanced capabilities that make cascading style sheets so powerful. For example, a blind user may want to save a series of style sheets which show only headers, only links, etc., and then view the same page using some or all of these style sheets in order to orient himself to the contents and organization of the page before reading any of the actual content.

11.4 In a dedicated section of the documentation , describe all features of the user agent that promote accessibility. [Priority 2]

Note. This is a more specific requirement than checkpoint 11.2.

Techniques:

In the documentation for each product feature, include information about accessibility. In an easy-to-find section on accessibility features, list all features that promote accessibility and link to them. A dedicated section documenting the features of the user agent that promote accessibility, however, should not be the only method of documenting such features.

11.5 Document changes between software releases. [Priority 2]

Techniques:

- Document changes to the user interface.
- At a minimum provide a text description of changes (e.g., in a README file).

---

3 Accessibility Topics

This section introduces some general techniques to promote accessibility in user agent functionality. A list of assistive technologies and browsers [USERAGENTS] designed for accessibility is available at the WAI Web site.

3.1 Access to content

Users must have access to document content, however they are browsing. Content can come from:

- the document source, both primary content and alternative equivalents . Document source includes element content, attribute values, and referenced content (e.g., images).
- style sheets.
- the user agent.

The most basic way to give users access to content is to render the entire document in one stream, whether it be a two-dimensional graphical layout, audio stream, or line-by-line Braille stream). However, user agents should do much more to ensure that users can understand a page by:

- Preserving structure when rendering
- Allowing the user to select specific content and query its structure or context
- Allowing access to alternative equivalents of content.
- Using and generating metadata to provide context
- Allowing the user to configure the user agent for different rendering options

These topics are addressed below.

3.1.1 Preserve and provide structure

Retain structure when rendering. For example, a graphical rendering of tables conveys relationships among cells. Serial renderings (e.g., to speech) must also make those relationships apparent, otherwise users will not know where a table cell ends, or a list item, etc. One technique for maintaining structure is to precede content with "header" information (upon user demand). For example, give the position of a table cell or it's associated headers. Or indicate the position of a list item within nested lists.

Provide "intelligent" structure that may not be exactly what the DTD says. For instance, in HTML, header elements do not nest, but presenting the document as hierarchical may give users a better sense of document structure. Use common idioms where known, even if they are not expressly in the DTD.

3.1.2 Allow access to selected content

In the Amaya browser [AMAYA] , users may access attribute values as follows: Place the cursor at the element in question, open/swap to the structure view. You are shown list of attributes and values. Another technique: select the element (press escape in Linux), then the attributes are all available from the attributes menu. For "alt", one can also look at the alternate view, which renders text equivalents instead of images - a lynx-like view. All the views are synchronized for navigation (and for editing).

Users may want to select content based on the rendering structure alone (i.e., that amounts to selecting across element borders).

Users may want to select content based on structure (e.g., a table cell). Amaya allows users to "climb" the document tree by positioning the cursor and pressing the Escape key. Each Escape selects one node higher in the document tree, up to the root.

3.1.3 Access to alternative equivalents of content

Speech-based user agents providing accessible solutions for images should, by default, provide *no* information about images for which the author has provided no text equivalent. The reason for this is that the image will clutter the user's view with unusable information adding to the confusion. In the case of an speech rendering, nothing should be spoken for the image element. This user should be able to turn off this option to find out what images were inaccessible so that the content author could be contacted to correct the problem.

In the case of videos, an assistive technology should, by default, notify the user that a video exists as this will likely result in the launch of a plug-in. In the case of a video, user agents should indicate what type of video it is, accompanied by any associated alternative equivalent. User agents should prefer plug-ins that support system-specific accessibility features over those that don't.

In the case of applets, an assistive technology should, by default, notify the user that an applet exists, as this will likely result in the launch of an associated plug-in or browser specific Java Virtual Machine. In the case of an applet, the notification should include any associated alternative equivalents . This is especially important since applets typically do provide an application frame that would provide application title information.

When an applet is loaded, it should support the Java system conventions for loading an assistive technology (refer to the appendix on loading assistive technologies for DOM access). When the applet receives content focus , the browser user agent should first notify the user about the applet as described in the previous paragraph and turn control over to the assistive technology that provides access to the Java applet.

Suppose an object with a preferred geometry is specified and not rendered, should the alternative equivalent be rendered in the preferred (but empty) region? What if the alternative equivalent exceeds the size of the preferred geometry? One option is to allow the user to specify through the UI whether to respect the preferred geometries or ignore them.

For information about alternative equivalents for SMIL content, refer to "Accessibility Features of SMIL" [SMIL-ACCESS] .

In HTML 4.0 [HTML40] , authors supply alternative equivalents for content as follows:

- For the IMG element (section 13.2): The "alt" (section 13.8), "title" (section 7.4.3), and "longdesc" (section 13.2) attributes.
- For the OBJECT element (section 13.3): The content of the element and the "title" attribute.
- For the deprecated APPLET element (section 13.4): The "alt" attribute and the content of the element.
- For the AREA element (section 13.6.1): The "alt" attribute.
- For the INPUT element (section 17.4): The "alt" attribute.
- For the ACRONYM and ABBR elements (section 9.2.1): The "title" attribute may be used for the acronym or abbreviation expansion.
- For the TABLE element (section 11.2.1), the "summary" attribute.
- For frames, the NOFRAMES element (section 16.4.1) and the "longdesc" attribute (section 16.2.2) on FRAME and IFRAME (section 16.5).
- For scripts, the NOSCRIPT element (section 18.3.1).

3.1.4 Missing alternative equivalents of content

- The "Altifier Tool" [ALTIFIER] illustrates smart techniques for generating text equivalents for images, etc. when the author hasn’t supplied any.
- If no captioning information is available and captioning is turned on, render "no captioning information available" in the captioning region of the viewport.

3.1.5 Context

In addition to providing information about content, user agents must provide contextual information. For example:

- table cell row/column position
- table cell header information.
- Nested list item numbers
- Content language

User agents can use style sheet languages such as CSS 2 [CSS2] and XSLT [XSLT] to generate contextual information.

Example.

The following XSLT style sheet (taken from the XSLT Recommendation [XSLT] , Section 7.7) shows how to one might number H4 elements in HTML with a three-part label:

```
<xsl:template match="H4">
   <fo:block>
     <xsl:number level="any" from="H1" count="H2"/>
     <xsl:text>.</xsl:text>
     <xsl:number level="any" from="H2" count="H3"/>
     <xsl:text>.</xsl:text>
     <xsl:number level="any" from="H3" count="H4"/>
     <xsl:text> </xsl:text>
     <xsl:apply-templates/>
   </fo:block>
  </xsl:template>
```

End example.

3.2 User control of style

To ensure accessibility, users must have **final control** over certain renderings.

- For changing text size, allow font size changes or provide a zoom mechanism.
- To hide content, use the CSS 'display' and 'visibility' properties ([CSS2] , sections 9.2.5 and 11.2, respectively).

Implement CSS ([CSS1] , [CSS2]) including the CSS 2 cascade order (section 6.4.1) and user style sheets. The CSS 2 cascade order ensures that user style sheets with "!important" (section 6.4.2) take precedence over author styles , giving users final control. Style sheets give authors design flexibility while offering users final control over presentation (refer also to Web Content Accessibility Guidelines 1.0 checkpoint 3.3 ([WAI-WEBCONTENT]). CSS should be implemented by user agents that implement CSS for text that it renders. CSS includes properties for audio, Braille (fixed and refreshable), screen, and print rendering, and all relevant properties for supported output media should be implemented.

Note that in the CSS cascade order, markup is given less weight than style sheet rules. Thus, an author may use both presentation markup and style sheets, and user agents that support style sheets will prefer the latter.

A user style sheet can be implemented through the user agent user interface , which means that the user may not have to understand how to write style sheets; they are generated or the user agent acts as though they were. For an example of this, refer to the style sheets implementation of Amaya [AMAYA] , which provides a GUI-based interface to create and apply internal style sheets. The same technique could be used to control a user style sheet.

For images, applets, and animations:

Background images may be controlled by the use of local style sheets, and more effectively if these can be dynamically updated. Animation rate depends on the players used. User agents that provide native rendering of animation (for example a movie player, a driver for animated GIF images, or a java machine) should enable the control of animation rates, or at least allow the user to stop, and to play frame-by-frame, as well as straight rendering. A user agent could provide control of the general timing of a presentation, combined with the ability to select from available tracks manually. An issue to bear in mind is that when animation is synchronized with audio, a user may need the ability to play the animation separately from the associated audio.

For time-based presentations:

Implement user controls to start, atop, rewind and pause presentations, and where multiple tracks are supported, to choose which tracks should be rendered. SMIL 1.0 [SMIL] provides for a number of these features. A SMIL implementation should provide for direct user control, as well as activation of the controls through a published API, for developers of assistive technologies.

For user agents rendering audio:

On selecting from among available description tracks. SMIL 1.0 [SMIL] allows users to specify captions in different languages. By setting language preferences in the SMIL player, users may access captions (or audio) in different languages.

The G2 player from Real Networks currently allows users to specify which language they prefer, which can be evaluated in a SMIL document to choose from among text or auditory tracks. Currently only one language can be indicated which does not permit choosing, for example, English spoken audio with Spanish captions.

The Quicktime player currently permits turning on and off any number of tracks individually, which can include audio, video, and text.

For user agents rendering video:

Implement the CSS positioning and/or SMIL layout languages. Allow the user to freeze a presentation, manually move and resize component visual tracks (including captions, subtitles and signed translations) and to apply CSS stylesheets to text-based presentation and SVG.

For user agents rendering speech:

CSS 2 aural style sheet properties ([CSS2] , section 19) can allow users to control speech rate, volume, and pitch. These can be implemented by allowing the user to write and apply a local style sheet, or can be automatically generated by means of (accessible) user controls, which should also be controllable through an API.

User interface:

- Allow the user to select large or small buttons and controls (and ensure that these values are applied consistently across the user interface)
- Allow the user to control features such as menu font sizes, or speech rates - this may be achieved through use of operating system standards.
- Allow the user to regroup buttons and controls, and reorder menus.

3.3 Link techniques

- Address broken link handling so that it doesn’t disorient users. For example, leave the viewport as is and notify user.
- Provide the user with media-independent information about the status of a link as the link is chosen. For example, do not rely solely on font styles or color changes to alert the user whether or not the link has previously been followed. The user should be able to pick from amongst a list of alert mechanisms (i.e. color changes, sound clips, status line messages, etc.), and should not be limited to only one type of alert mechanism.
    - For assistive technologies: Provide the user with the option to have the "title" (if present) or the hyperlink text made available to the user when the user navigates from link to link.
- Alert the user if following a link involves the payment of a fee.
- When presenting the user with a list of the hyperlinks contained in a document, allow the user to choose between "Display links using hyperlink text" or "Display links by title (if present)", with an option to toggle between the two views. For a link without a title, use the link text.
    - Provide the user with orientation information about the listed links. For example, identify a selected link as "Link X of Y", where "Y" is the total number of links available in the document.
- Offer the user a list of links which have been visited and a list of links which have not yet been visited, or provide a media-independent mechanism to distinguish between visited and unvisited links. Do _not_ rely on visual or aural prompts *alone* to signify the difference between visited and unvisited links.
- Offer the user a list of links which are internal (i.e., local to document) and those which are external, or provide a media-independent mechanism to distinguish between external and internal links in a list of links. Do **not** rely on visual or aural prompts *alone* to signify the difference between internal and external links.
- Use the CSS2 ’:before’ pseudo-elements ([CSS2] , section 5.12.3) to clearly indicate that something is a link (e.g., ’A:before { content : "LINK:" }’).

- Implement the CSS pseudo-class ':hover'.

Lynx allows the user to choose from the following options for images without "alt" supplied:

- Insert a generic placeholder (e.g., [IMAGE]) in place of the image.
- Insert the file name in place of the image.
- Render nothing.

The same technique might be used when "alt" is supplied but whitespace only. However, if an image with empty or whitespace "alt" text is part of a link:

- Insert a generic placeholder (e.g., [LINK]) in place of the image.
- If supplied for the link element, render the "title" attribute.
- Otherwise, if the link designates an HTML document, use the content of the TITLE element in that document as link text.
- Otherwise render the filename or URI of the designated resource.

Lynx [LYNX] numbers each link and other element and provides information about the relative position of the section of the document. Position is relative to the current page and the number of the current page out of all pages. Each page usually has 24 lines.

Information about link status and other properties can be provided in an information view such as that provided by Netscape Navigator about how many and what types of elements are in a document.

User agents should not consider that all local links (to anchors in the same page) have been visited when the page has been visited.

User agents may use graphical or aural icons to indicate visited links or broken links.

Users should be able to:

- Configure what information about links they wish presented to them.
- Turn on and off automatic rendering of this information when a link receives content focus .
- Get information about a link on demand, even if automatic rendering has been turned off.

3.4 List techniques

Ordered lists help non-visual users navigate. Non-visual users may "get lost" in lists, especially in nested lists and those that do not indicate the specific nest level for each list item. Until user agents provide a means to identify list context clearly (e.g., by supporting the ':before' pseudo-element in CSS2), content developers should include contextual clues in their lists.

For numbered lists, compound numbers (or letters, numbers, etc.) are more informative than simple numbers. Thus, a list numbered "1, 1.1, 1.2, 1.2.1, 1.3, 2, 2.1," provides more context than the same list without compound numbers, which might be formatted as follows:

```
1.
  1.
  2.
    1.
  3.
2.
  1.
```

and would be spoken as "1, 1, 2, 1, 2, 3, 2, 1", conveying no information about list depth.

CSS ([CSS1] , [CSS2]) allow users to control number styles (for all list, not just ordered) through user style sheets.

Example.

The following CSS 2 style sheet (taken from CSS 2, section 12.5) shows how to specify compound numbers for nested lists created with either UL or OL elements. Items are numbered as "1", "1.1", "1.1.1", etc.

```
<STYLE type="text/css">
   UL, OL { counter-reset: item }
   LI { display: block }
   LI:before { content: counters(item, "."); counter-increment: item }
</STYLE>
```

End example.

Even without CSS, user agents may allow users to turn on and off contextual rendering of nested lists.

3.5 Table techniques

Tables were designed to structure relationships among data. In graphical media, tables are often rendered on a two-dimensional grid, but this is just one possible interpretation of the data. On the Web, the HTML TABLE element has been used more often than not to achieve a formatting effect ("layout tables") rather than as a way to structure true tabular data ("data tables").

Layout tables cause problems for some screen readers and when rendered, confuse users. Even data tables can be difficult to understand for users that browse in essentially one dimension, i.e. for whom tables are rendered serially. The content of any table cell that visually wraps onto more than one line can be a problem. If only one cell has content that wraps, there is less problem if it is in the last column. Large tables pose particular problems since remembering cell position and header information becomes more difficult as the table grows.

User agents facilitate browsing by providing access to specific table cells and their associated header information. How headers are associated with table cells is markup language-dependent.

Tabular navigation is required by people with visual disabilities and some types of learning disabilities to determine the content of a particular cell and spatial relationships between cells (which may convey information). If table navigation is not available users with some types of visual disabilities and learning disabilities may not be able to understand the purpose of a table or table cell.

3.5.1 Table rendering

A linear view of tables -- cells presented row by row or column by column -- can be useful, but generally only for simple tables. Where more complex structures are designed, allowing for the reading of a whole column from header downward is important as is carrying the ability to perceive which header belongs to which column or group of columns if more than one is spanned by that header. It is important for whole cells to be made available as chunks of data in a logical form. It might be that a header spans several cells so the header associated with that cell is part of the document chunk for that and each of the other cells spanned by that header. Inside the cell, order is important. It must be possible to understand what the relationships of the items in a cell are to each other.

Properly constructed data tables generally have distinct TH head cells and TD data cells. The TD cell content gains implicit identification from TH cells in the same column and/or row.

For layout tables, a user agent can assist the reader by indicating that no relationships among cells should be expected. Authors should not use TH cells just for their formatting purpose in layout tables, as those TH cells imply that some TD cells should gain meaning from the TH cell content.

When a table is "read" from the screen, the contents of multiline cells may become intermingled. For example, consider the following table:

```
This is the top left cell    This is the top right cell
of the table.                of the table.

This is the bottom left      This is the bottom right
cell of the table.           cell of the table.
```

If read directly from the screen, this table might be rendered as "This is the top left cell This is the top right cell", which would be confusing to the user.

A user agent should provide a means of determining the contents of cells as discrete from neighboring cells, regardless of the size and formatting of the cells. This information is made available through the DOM [DOM1]).

3.5.2 Table rendering as speech

The following techniques for speaking data tables are adapted from the "Tape Recording Manual" produced by the National Braille Association.

1. Read the title, source, captions and any explanatory keys.
2. Describe the structure of the table. Include the number of columns, the headings of each column and any associated sub-columns, reading from left to right. The subhead is not considered a column. If column heads have footnotes, read them following each heading.
3. Explain whether the table will be read by rows (horizontally) or by columns (vertically). The horizontal reading is usual but, in some cases, the vertical reading better conveys the content. On rare occasions it is necessary to read a table both ways.
4. Repeat the column headings with the figures under them for the first two rows. If the table is long, repeat the headings every fifth row. Always repeat them during the reading of the last row.
5. Indicate the last row by saying, "and finally . . . " or "last row ..."
6. At the completion of the reading say "End table X." If table appeared on a page other than the one you were recording, add "Returning to text on page Y."

3.5.3 Cell rendering

Non-graphical rendering of information by a browser or an assistive technology working through a browser will generally not render more than a single cell, or a few adjacent cells at a time. Because of this, the location of a cell of interest within a large table may be difficult to determine for the users of non-graphical rendering.

In order to provide equivalent access to these users, compliant browsers should provide a means of determining the row and column coordinates of the cell having the selection via input (e.g., keyboard) commands. Additionally, to allow the user of a non-graphical rendering technology to return to a cell, the browser should allow a means of moving the selection to a cell based on its row and column coordinates.

At the time the user enters a table, or while the selection is located within a table, the user agent should allow an assistive technology to provide information to the user regarding the dimensions (in rows and columns) of the table. This information, in combination with the summary, title, and caption, can allow the user with a disability to quickly decide whether to explore the table of skip over it.

Dimensions is an appropriate term, though dimensions needn’t be constants. For example a table description could read: "4 columns for 4 rows with 2 header rows. In those 2 header rows the first two columns have "colspan=2". The last two columns have a common header and two subheads. The first column, after the first two rows, contains the row headers.

Some parts of a table may have 2 dimensions, others three, others four, etc. Dimensionality higher than 2 are projected onto 2 in a table presentation.

The contents of a cell in a data table are generally only comprehensible in context (i.e., with associated header information, row/column position, neighboring cell information etc.). User agents provide users with header information and other contextual information. Techniques for rendering cells include:

- Provide this information through an API.
- Render cells as blocks. This may assist some screen readers. Using this strategy, the user agent might render individual cells with the relevant top and side headers attached.
- Allow navigation and querying of cell/header information. When the selection is on an individual cell, the user would be able to use a keyboard command to receive the top and left header information for that cell. The user agent should appropriately account for headers that span multiple cells.
- Allow users to read one table column or row at a time, which may help them identify headers.
- Ignore table markup entirely. This may assist some screen readers. However, for anything more than simple tables, this technique may lead to confusion.

3.5.4 Cell header algorithm

User agents should use the HTML 4.0 algorithm to calculate header information ([HTML40] , section 11.4.3).

Since not all tables are designed with the header information, user agents should provide, as an option, a "best guess" of the header information for a cell. Note that data tables may be organized top-to-bottom, bottom-to-top, right-to-left, and left-to-right, so user agents should consider all edge rows when seeking header information.

Some repair strategies for finding header information include:

- Consider that the top or bottom row to contains header information.
- Consider that the leftmost or rightmost column in a column group contains header information.
- If cells in an edge row or column span more than one row or column, consider the following row or column to contain header information as well.

The user may choose the form and amount of this information, possibly announcing the row heads only once and then the column head or its abbreviation ("abbr") to announce the cell content.

Issues to consider:

1. TH cells on both the left and right of the table need to be considered.
2. For TH cells with "rowspan" set: the content of those TH cells must be considered for each of the N-1 rows below the one containing that TH content.
3. An internal TH in a row surrounded on either side by TDs has no means to specify to which (row or column) that TH overrides what existed to its left or above it.

4. Finding column header cells assumes they are all above the TD cell to which they apply.
5. A TH with "colspan" set needs to be included in the list of TH for the M-1 columns to the right of the column in which the TH is found.

If the user agent is taking a guess at header information, the user agent might find two or more possibilities. Provide the user with a mechanism to review the possible choices and make a selection.

3.5.5 Table metadata

Users of screen readers or other serial access devices cannot easily glean information about a page "at a glance". This is particularly difficult when accessing two-dimensional tables and trying to determine their content. Therefore, contextual information about tables (available from author-supplied markup or generated by the user agent) is very important to making them accessible.

Text metadata about tables can come from a number of elements, attributes, the structure of the table itself, or other sources. Useful information to make available to users includes:

- The table caption or summary information.
- The number of column groups and columns.
- The number of row groups and rows, in particular information about table headers and footers.
- Which rows contain header information (whether at the top or bottom of the table).
- Which columns contain header information (whether at the left or right of the table).
- Whether there are subheads.
- How many rows or columns a header spans.
- The row/column dimensions of the table.

The user should be able to get table summary information from inside a cell. It might be helpful to provide two types of table summary information, i.e. a brief summary and a more detailed summary.

3.5.6 Table navigation

All users should be able to determine quickly the nature and purpose of a table. Examining the table visually often conveys a sense of the table contents with a quick scan of the cells. Users with blindness or low vision, users who have difficulty translating printed material, or users in an eyes-busy or speech-based environment may not able to do this. Table summary information can convey the nature of a table; in HTML, summary information for tables comes from the "summary" attribute on the TABLE element as well as the CAPTION element.

An auditory rendering agent, when the point-of-regard moves to a table, might say, "Table: Tax tables for 1998," thus identifying the nature of the table. The user could then use keyboard commands to move the selection to the next logical block of information, or use a different command to "burrow" into the table.

The "burrow" command should have an opposite "up" command, which would move the selection from an individual cell to the table as a whole, so that the user can leave a table from any cell within it, rather than navigating to the end.

If the user moves the content focus up to look over the summary information, it should be possible to burrow back to the same cell.

When navigating a table that contains another table, this strategy can avoid confusion. For example, if each row of a table contained five cells, but the second row contained a 4x4 table in the third cell, a user could be disoriented when the row did not end as expected. However, when the selection moved to the third cell of the table, a compliant browser would report that this was a table, and describe its contents. The user would have the option of navigating to the fourth cell of the parent table, or burrowing into the table within this cell.

When rendering tabular information, the fact that it is tabular information should be apparent. For a graphical user agent, such information is commonly made obvious by the border attribute or by visually apparent aligned white space between columns. However, for a non-graphical agent, such information must also be made evident.

As the user agent shifts the selection to a table, it should first allow users to access summary information about the table (e.g., the CAPTION element or the "summary" attribute in HTML). Access to this information allows the user to determine whether or not to examine the contents of the table, or to move the selection to the next block of content. Users should be able to choose *not* to have the summary information presented, if, for example, they visit a table frequently and don’t want to hear the summary information repeated each time.

In many data tables, the meaning of the contents of a cell are related to the contents of adjacent cells. For example, in a table of sales figures, the sales for the current quarter might be best understood in relation to the sales for the previous quarter, located in the adjacent cell.

In order to provide access to contextual information for individuals using non-graphical browsers, or for individuals with certain types of learning disabilities, it is necessary for the user agent to allow the selection to be moved from cell to cell, both right/left and up/down via keyboard commands. The UA should inform the user when navigation has led to a table edge.

The most direct method of performing such navigation would be via the cursor keys, though other navigation strategies might be used.

Users of graphical browsers can easily locate cells within a table that are at the intersection of a row and column of interest. To provide equivalent access to users of non-graphical browsers, equivalent means of navigation should be provided. The search function of a browser will allow the user to locate key terms within a table, but will not allow the user to find cells that are at the intersection of rows and columns of

interest.

A rich set of navigation functions could include:

- jump to specific cell (by row/column position).
- up/down 1 or more rows
- left/right 1 or more columns
- bottom row in same column
- right column in same row
- jump to row headers for cell
- jump to column headers for cell
- jump back to cell
- go to first or last cell in a row or column.
- relative and direct navigation. For example, entering "-3, 20" might mean "left three cells, up 20 cells").
- Allow navigation of table headers or footers only.

In some tables, cells may span more than one row or column and this affects navigation techniques. For example, if you navigate up into a cell which spans three columns, which cell above the span cell should you go into if you go up another cell? Or what happens if you are in the last cell of a row and the previous row has fewer columns?

3.5.7 Table search techniques

- An advanced search mode might provide entries for header information, allowing the user to find information at the intersection of columns and rows using the key terms.
- A search mode might allow the user to search for key terms that are related to key header terms, allowing searches to be restricted to specific rows or headers within a table.

The header information visible in a TH cell may be abbreviated, in which case it should be user preference to see the "abbr" value if any or the full contents.

Axis information may also help the user search into confined portions of the table.

Column groups and row groups are other confining partitions of a table in which a search may be limited.

Software:

- Table navigation script from the Trace Center

3.6 Frame techniques

Frames were originally designed for use by graphical user interfaces to allow the graphical viewport to be broken up into pieces that could change independently (e.g,. selecting an entry in a table of contents in one frame changes the contents of a second frame). However Frames can pose problems users who rely on synthesized speech, refreshable Braille, and magnified views. The ability to access frame alternatives is also important for some users with cognitive disabilities. Problems include:

- Orientation: What frame am I in? How is the frameset organized? What is the relationship among frames? What happens in frame B when I select a link in frame A?
- Navigation: How do I get from frame to frame?

To help users, user agents should:

- Consider the author's alternative presentation to frames (e.g., provided by the HTML 4.0 NOFRAMES element ([HTML40] , section 16.4.1).
- Inform the user that they are viewing a frameset.
- Provide information about the number of frames in the frameset.
- Provide (possibly nested) lists of links to each frame in the frameset. The link text can be the frame title (given by "title" or "name" if "title" is not present). Or, if no title or name are available, render the title (e.g., the HTML TITLE element [HTML40] , section 7.4.2) of the document that is loaded into the frame. Other alternative renderings for a frameset include simply rendering each frame in the frameset sequentially as a block (e.g., aligned vertically in a graphical environment).
- Highlight the current frameset (e.g., with a thick border, by displaying the name of the current frameset in the status bar, etc.
- Provide information about the current frame. Make available frame title for speech synthesizers and Braille devices.
- If a page does not have a list of links within a frame available outside the frame, make the list available outside the frame.
- Allow navigation between frames (forward and backward through the nested structure, return to global list of links to frames). **Note.** Recall that the user must be able to navigate frames through all supported input devices.
- Allow navigation to alternative equivalents.
- Allow the user to bookmark the current frame.
- Inform the user if an action in one frame causes the content of another frame to change. Allow the user to navigate quickly to the frame(s) that changed.

To name frames in HTML, use:

1. The "title" attribute on FRAME, or if not present,
2. The "name" attribute on FRAME, or if not present,

3. Title information of the referenced frame source (e.g., the TITLE element of the source HTML document), or
4. Title information of the referenced long description (e.g., what "longdesc" refers to in HTML), or
5. Frame context (e.g., "Frame 2.1.3" to indicate the path to this frame in nested framesets).

Users may also use information about the number of images and words in the frame to guess the purpose of the frame. For example, few images and few words is probably a title, more words is probably an index, many words is probably text area.

Frame structure information should be available through the DOM and appropriate accessibility interfaces. Using DOM and operating specific accessibility API to expose frame information provides one means for assistive technologies to provide alternative control of frames and rendering of frame information. The user agent should fully implement the DOM Level 1 Recommendation [DOM1] API related to frames: HTMLFrameSetElement, HTMLFrameElement, and HTMLIFrameElement.

For people with visual disabilities who enlarge text on the screen to improve readability, frames become distorted and unusable. Other users with cognitive disabilities sometimes become disoriented in complex side-by-side frame configurations. To improve access to frames, user agents should allow frames to be viewed as a list so the user can identify the number of frames and the functions of each frame. If NOFRAMES information is present it should also be rendered so the user can optionally use that view of the information.

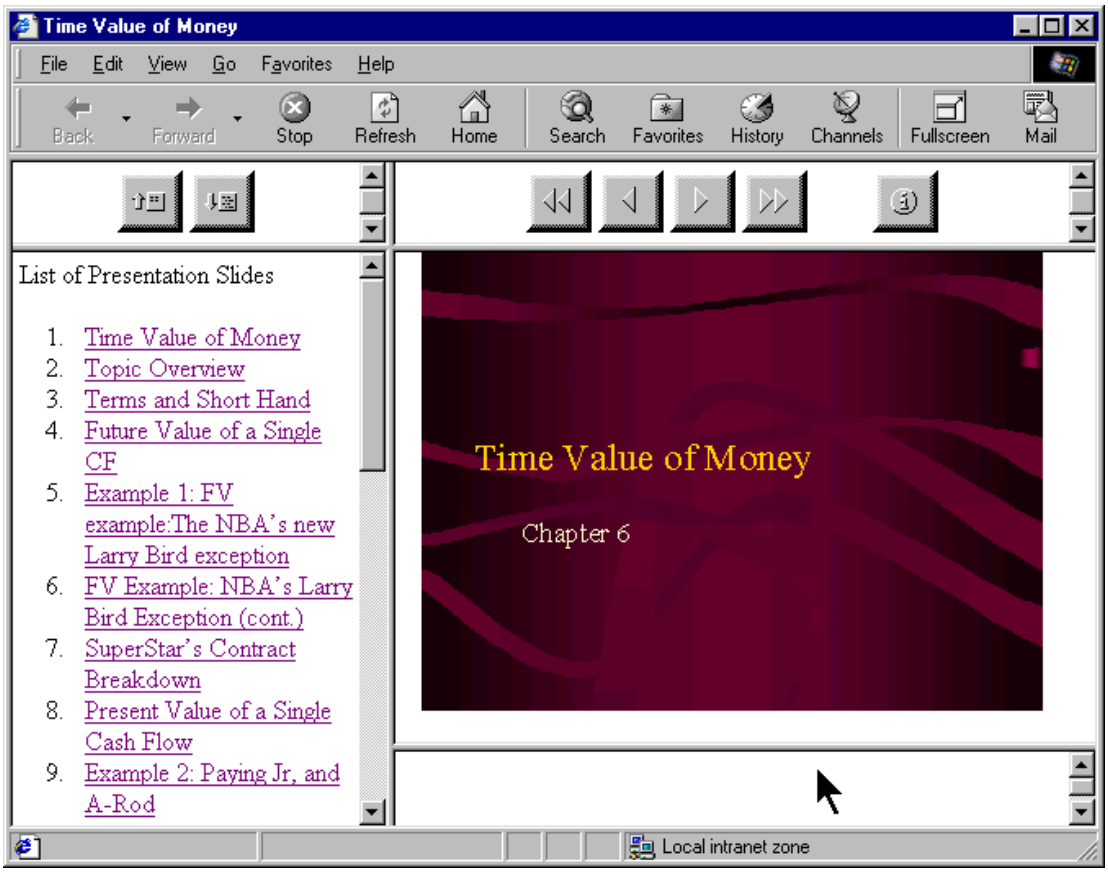
Consider renderings of the following document:

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Frameset//EN">
<HTML lang="en">
<HEAD>
  <META http-equiv="Content-Type"
          content="text/html; charset=iso-8859-1">
  <TITLE>Time Value of Money</TITLE>
</HEAD>

<FRAMESET COLS="*, 388">
  <FRAMESET ROWS="51, *">
    <FRAME src="sizebtn" marginheight="5" marginwidth="1"
           name="Size buttons" title="Size buttons">
    <FRAME src="outlinec" marginheight="4" marginwidth="4"
           name="Presentation Outline"
           title="Presentation Outline">
  </FRAMESET>

  <FRAMESET ROWS="51, 280, *">
    <FRAME src="navbtn" marginheight="5" marginwidth="1"
           name="Navigation buttons"
           title="Navigation buttons">
    <FRAME src="slide001" marginheight="0" marginwidth="0"
          name="Slide Image" title="Slide Image">
    <FRAME src="note001" name="Notes" title="Notes">
  </FRAMESET>
```

```
<NOFRAMES>
<P>List of Presentation Slides</P>
<OL>
<LI><A HREF="slide001">Time Value of Money</A>
<LI><A HREF="slide002">Topic Overview</A>
<LI><A HREF="slide003">Terms and Short Hand</A>
<LI><A HREF="slide004">Future Value of a Single CF</A>
<LI><A HREF="slide005">Example 1: FV example:The
NBAŸs new Larry Bird exception</A>
<LI><A HREF="slide006">FV Example: NBAŸs Larry
Bird Exception (cont.)</A>
<LI><A HREF="slide007">SuperStarŸs Contract
Breakdown</A>
<LI><A HREF="slide008">Present Value of a Single
Cash Flow</A>
<LI><A HREF="slide009">Example 2: Paying Jr, and
A-Rod</A>
<LI><A HREF="slide010">Example 3: Finding Rate of
Return or Interest Rate</A>
<LI><A HREF="slide011">Annuities</A>
<LI><A HREF="slide012">FV of Annuities</A>
<LI><A HREF="slide013">PV of Annuities</A>
<LI><A HREF="slide014">Example 4: Invest Early in
an IRA</A>
<LI><A HREF="slide015">Example 4 Solution</A>
<LI><A HREF="slide016">Example 5: Lotto Fever
</A>
<LI><A HREF="slide017">Uneven Cash Flows: Example
6:Fun with the CF function</A>
<LI><A HREF="slide018">Example 6 CF worksheet inputs</A>
<LI><A HREF="slide019">CF inputs continued</A>
<LI><A HREF="slide020">Non-Annual Interest
Compounding</A>
<LI><A HREF="slide021">Example 7: What rate are
you really paying?</A>
<LI><A HREF="slide022">Nominal to EAR Calculator</A>
<LI><A HREF="slide023">Continuous Interest Compounding</A>
<LI><A HREF="slide024">FV and PV with non-annual
interest compounding</A>
<LI><A HREF="slide025">Non-annual annuities</A>
<LI><A HREF="slide026">Example 8: Finding Monthly
Mortgage Payment</A>
<LI><A HREF="slide027">solution to Example 8</A>
</OL>
</NOFRAMES>
</FRAMESET>
</HTML>
```

The following illustrate how some user agents handle this frameset.

First, rendering in Microsoft Internet Explorer 5.0 on a Windows platform:

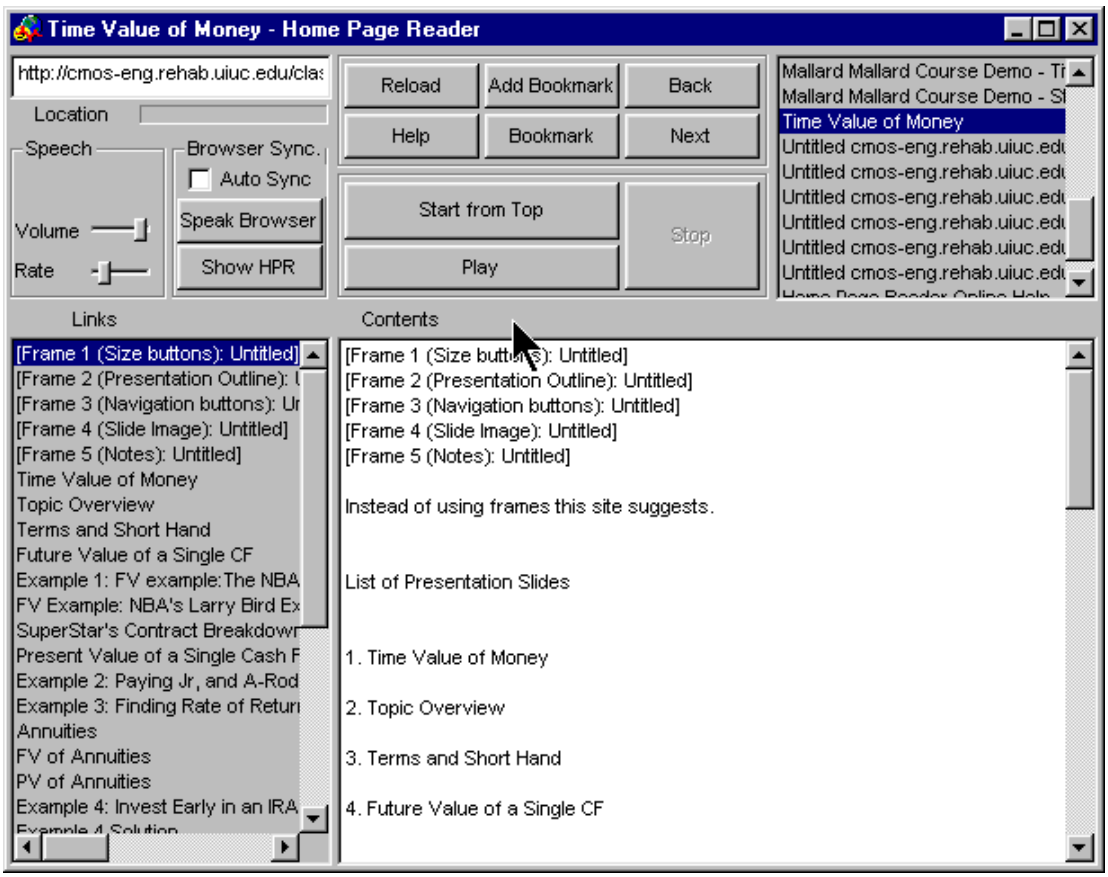


Rendering by Lynx on Linux:

```
                                   Time Value of Money

FRAME: Size buttons
FRAME: Presentation Outline
FRAME: Navigation buttons
FRAME: Slide Image
FRAME: Notes

List of Presentation Slides
 1. Time Value of Money
 2. Topic Overview
 3. Terms and Short Hand
 4. Future Value of a Single CF
 5. Example 1: FV example:The NBA's new Larry Bird exception
 6. FV Example: NBA's Larry Bird Exception (cont.)
 7. SuperStar's Contract Breakdown
 8. Present Value of a Single Cash Flow
 9. Example 2: Paying Jr, and A-Rod
10. Example 3: Finding Rate of Return or Interest Rate
11. Annuities
12. FV of Annuities
13. PV of Annuities
14. Example 4: Invest Early in an IRA
15. Example 4 Solution
```

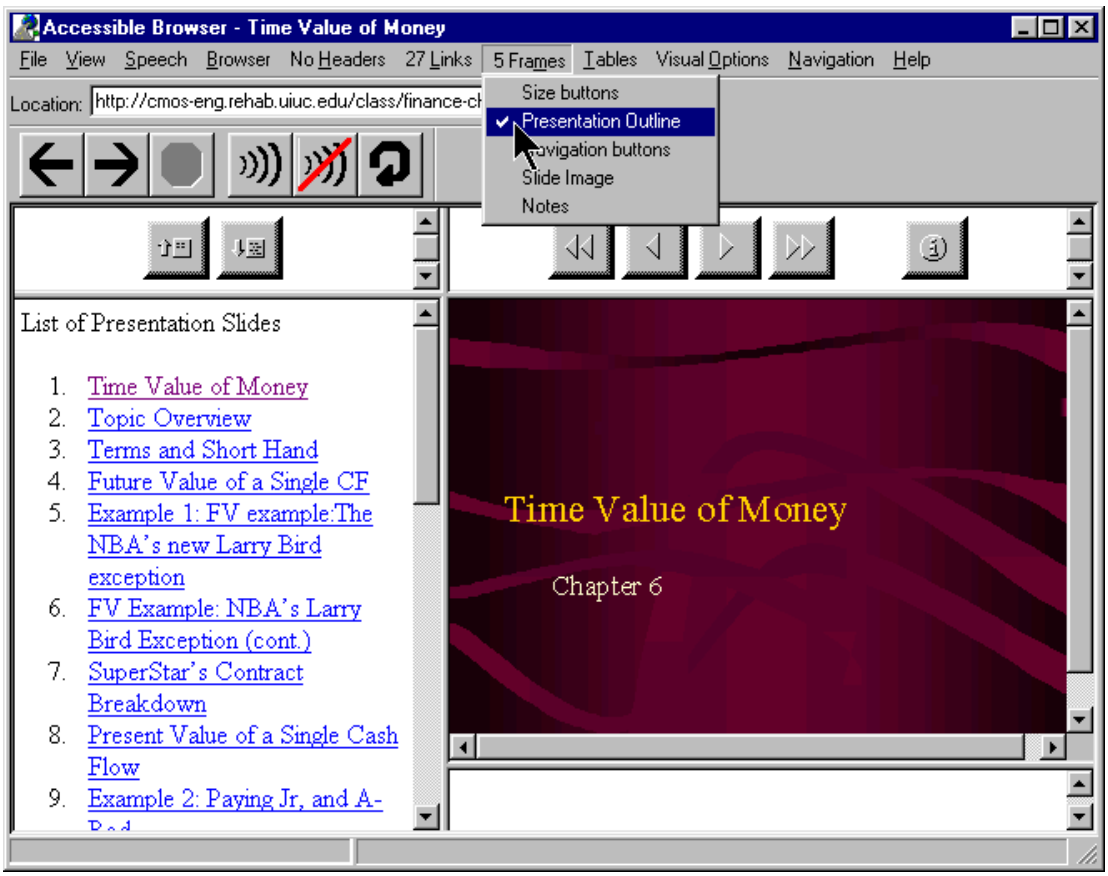
```
16. Example 5: Lotto Fever
17. Uneven Cash Flows: Example 6:Fun with the CF function
18. Example 6 CF worksheet inputs
19. CF inputs continued
20. Non-Annual Interest Compounding
21. Example 7: What rate are you really paying?
22. Nominal to EAR Calculator
23. Continuous Interest Compounding
24. FV and PV with non-annual interest compounding
25. Non-annual annuities
26. Example 8: Finding Monthly Mortgage Payment
27. solution to Example 8
```

Graphical rendering by Home Page Reader on Windows:



Audio rendering by Home Page Reader on Windows: @@add here?@@

User agents may also indicate the number of frames in a document and which frame is the current frame via the menu bar or popup menus. Users can configure the user agent to include a FRAMES menu item in their menu bar. The menu bar makes the information highly visible to all users and is very accessible to assistive technologies. In the following snapshot, the menu bar indicates the number of frames and a check next to the name of the frame element indicates which is the current frame:



3.7 Form techniques

For labels explicitly associated with form controls (e.g., "for" attribute on LABEL in HTML), make available label information when the user is navigating among the form controls. This information must be provided in a device-independent manner, and the user should be able to choose from a list of mechanisms that provide access to the content of the label.

For semantic information explicitly associated with groupings of form controls (e.g., groupings of radio buttons or checkboxes contained in a FIELDSET), make available the information contained in the LEGEND defined for the FIELDSET to the user. This information must be provided in a device-independent manner, and the user should be able to choose from a list of mechanisms that provide access to the content of the LEGEND.

Provide information about the percentage of form that has already been filled out as the user moves through the form controls. This information must be provided in a device-independent manner. The user should also be able to query the user agent through a simple, well-documented mechanism (such as a keystroke or keystroke combination) to learn what percentage of the form has been completed.

Allow the user to know what percentage of a form has been completed as the user navigates the form. will help users avoid prematurely submitting an incomplete form. This is particularly important for anyone moving through a form sequentially; users who encounter a submit button usually think this means the end of a form, but it may not be. (Refer also to the technique detailing methods of providing users with orientation information about individual form controls when a form control receives content focus for a more detailed discussion of this issue.)

Provide the user with orientation information about a form. Users should be able to query the user agent for:

- the presence of a form -- the user should be able to query to user agent for the presence of a form within the document being rendered. Some user agents (such as Opera and Netscape Navigator) already indirectly provide such functionality in a non-interactive manner, through the provision of "form navigation" keyboard commands. When invoked, these "form navigation" commands move the user agent's current focus to the first form field contained in the document currently being rendered (provided, of course, that the document contains a form. Although providing discrete "form navigation" commands allows users to quickly move to the first form field within a document, users need to be explicitly notified if the document does not contain a form. Such notification should be conveyed in a device-independent manner, and the user should not be limited to one means of notification (i.e., display a message on the status bar and play a sound).
- the number of forms in a document

Provide the user with orientation information about individual form controls when a form control receives content focus . For example, the most basic orientation information would be to identify the form control with focus as "Field X of Y", where "Y" is the total number of fields contained in the form. This will help prevent users accessing the form serially (such as a blind user using a screen reader or someone using a voice browser over a phone) from prematurely invoking the form's submit mechanism. It is a common practice for forms (particularly those used to query search engines) to be laid out visually, so that the submit and reset buttons (if present) immediately follow a text-entry field, despite the presence of other form controls (such as radio buttons and checkboxes) within the FORM element. A user accessing such a form in a serial manner, therefore, is likely to mistake the submit button for the end of the form, and activate it, unaware that it is followed by further form controls which could -- in the example of a search engine query submission form -- prove an invaluable aid in tailoring the content being submitted via the form. Use of such orientation information (i.e., "Field X of Y" or the percentage of the form completed) will also decrease the amount of time needed to submit the form (a crucial consideration when forms are being used to facilitate bidding for online auctions) as well as reduce the frustration of the end user, who, due to the visually oriented layout of the form, is confused when the submission of the form repeatedly leads to a message such as "Form Incomplete - Use your browser's back button to return to the form".

When a document contains more than one form, form control orientation information should also include data which will identify to which form the form control with focus belongs. Notification could take the form: `Form Z: Field X of Y`

where "Z" identifies the form, "X" the form field with focus an "Y" the total number of form fields contained in "Form Z".

Provide more detailed orientation information pertaining to form:

- When a grouping of radio buttons receives content focus , identify the radio button with content focus as "Radio Button X of Y", where "Y" represents the total number of radio buttons in the grouping. HTML 4.0 HTML 4.0 specifies the FIELDSET element ([HTML40] , section 17.10), which allows authors to group thematically related controls and labels. The LEGEND element ([HTML40] , section 17.10) assigns a caption to a FIELDSET. If a LEGEND has been defined for the grouping of radio boxes, use the information contained within the LEGEND to more precisely identify the number of radio buttons in the grouping. For example, if the LEGEND element has been used to identify a FIELDSET of radio buttons, each of which has a LABEL element ([HTML40] , section 17.9.1) associated with it, as "Connection Rate", identify the radio button as it receives content focus as "Connection Rate: Radio button X of Y: 28.8kpbs", where "Y" represents the total number of radio buttons in the grouping and "28.8kbps" is the information contained in the LABEL associated with the radio button with content focus.
- Provide information about what is required for each form control. GUI browsers, for example, could convey such information via context-sensitive help. Lynx conveys this information by providing information about the currently selected form control via a status line message:
  - (Radio Button) Use right-arrow or RETURN to toggle
  - (Checkbox Field) Use right-arrow or RETURN to toggle
  - (Option List) Hit return and use arrow keys and return to select option
  - (Text Entry Field) Enter Text. Use UP or DOWN arrows or "tab" to move off
  - (Textarea) Enter text. UP/DOWN arrows or "tab" to move off (^Ve for editor)
    Note. The ^Ve (caret-V, e) command, included in the TEXTAREA status line message, enables the user to invoke an external editor defined in the local Lynx configuration file (lynx.cfg). For more information, please refer to the following technique.

Allow the user to invoke an external editor when a TEXTAREA receives content focus . A user may wish to use an external editor, rather than enter text directly in a TEXTAREA for myriad reasons, including:

- the ability to more efficiently and expeditiously review the text being input
- the ability to spell check the text being input
- the ability to use macros or other special features of the external editor, including the ability to increase the contrast between foreground and background colors, access to a wider range of screen-display fonts, etc.

- the ability to save a local copy of the text being input
- the user's familiarity with the external editor will encourage the user to actually enter text into a TEXTAREA--an exercise which is often an extremely daunting task, given the limitations imposed by the physical dimensions of the TEXTAREA. A user will also find it much easier to review what he or she has typed when using an external editor.

Provide information about the order of form controls (e.g., as specified by "tabindex" in HTML). This is important since:

- most forms are visually oriented, employing changes in font size and color
- users who access forms serially need to know they have supplied all the necessary information before submitting the form.

Provide information about required fields. Since authors often use color changes, font styling, or a graphical symbol alone to express that a field is required, the user should be able to configure the user agent so that it alerts him that the field is required for submission of the form content. Strategies for achieving this include:

- Allow the user to view a list of required form fields. Such a list should be invokable via a simple and well documented keybinding.
- Allow the user to define an alert mechanism (such as the playing of a sound) which will be invoked when a required field receives content focus . The user should be able to pick from amongst a list of alert mechanisms (i.e. color or font-style changes to the field label, the playing of a sound clip, a status line message, etc.), and should not be limited to only one type of alert mechanism. Do **not** rely on visual or aural prompts alone to signify a required form field.

Allow the user to configure the user agent so that SELECT form fields which use the "multiple" attribute to allow the end user to select more than one OPTION can be transformed into a list of checkboxes.

- Preserve the LABELs set for the OPTGROUP and each individual OPTION, and re-associate them with the user agent generated checkboxes. The LABEL defined for the OPTGROUP should be converted into a LEGEND for the resultant FIELDSET, and each checkbox should retain the LABEL defined for the corresponding OPTION.
- **Note.** Lynx automatically transforms SELECT form fields which use the "multiple" attribute to allow the end user to select more than one OPTION into checkboxes.

Allow the user to exit a menu without selecting any option. For example, when navigating through OPTION's, have some key like the ESC key ot exit the list of OPTION's without making a selection.

Allow the user to configure the user agent sot that SELECT form fields can be transformed into a list of radio buttons.

- Any such transformation should retain the accessibility information defined for the original form controls.
- **Note.** Lynx provides this functionality as a configurable option, which can be changed on-the-fly while a page is being rendered. To promote the comprehensibility of the transformed output for users using screen-readers and refreshable Braille displays, Lynx places each OPTION that it transforms into a radio button on a separate line.

3.7.1 Form submission techniques

Users (notably users with blindness or any user unaccustomed to online forms) do not want forms to be submitted without their consent, e.g., when submitted through scripts. In this case user agents should request confirmation before submitting the form content. Nor do they wish to be prompted before each form submission when they have explicitly submitted the form (e.g., through the standard submit button).

Inadvertently pressing the RETURN or ENTER key is quite a prevalent phenomenon among users of every level of expertise - especially those who often find it necessary to switch between user agents. Lynx, for example, uses the ENTER key within FORMs as a means of exposing drop-down (or pop-up, depending upon your point of view) SELECT menus. Thus, when one encounters a SELECT menu using Lynx, one: exposes the content of the menu by pressing the ENTER key, and then is able to navigate between OPTIONs using the up and down arrows or via Lynx's text-search feature. When one finds the appropriate OPTION, it is selected by pressing ENTER, which causes the selected item to be displayed in the SELECT menu listbox.

The problem posed by the default "submit on enter" feature of most GUI browsers is not limited to the SELECT menu problem outlined above. Lynx (as well as several other text-based browsers) uses the ENTER/RETURN key as a means of toggling several FORM controls, such as the selection of checkboxes and radio buttons.

Speech users may be frustrated and misdirected by the use of javascript and event handler controlled pseudo-forms, wherein the user is presented with a menu (in the form of a listbox in GUI browsers), and is redirected to a different viewport upon selection of an OPTION. The markup behind such pseudo-forms is a mix of javascript (in particular the "function switchpage(select)" command) and HTML FORM controls, which utilize HTML4's event handler script attributes (in particular the "onchange" event handler attribute has been defined. An example (gleaned from the document source for one Web site follows:

```
<SELECT NAME="condition" onchange="switchpage(this)">
```

When such a menu is encountered by a individual who is using speech synthesis in conjunction with a javascript enabled user agent, his or her instinctual reaction will be to use the UA's navigation mechanism (usually the up and down arrows) to review the available OPTIONs. However, each time a new OPTION is displayed, the user is abruptly taken to a new viewport. Conversely, if one is using a user agent that does not support javascript (or has javascript support disabled), then the menu

is displayed, but since there is no SUBMIT mechanism associated with it, there is no mechanism by which one can use the menu to quickly switch viewports - the apparent purpose of this type of pseudo-form. And while one can avoid having the viewport abruptly changed when encountering the menu (at least in the Windows environment) by using the ALT-LEFT-ARROW keystroke to display the menu in a drop-down list, (a) very few users know this keystroke, and (b) when one encounters a listbox on a page in an aural environment, one usually assumes that he or she is navigating a valid FORM, in which there are no unexpected side effects to perusing the contents of a SELECT menu using the arrow keys

Refer also to Web Content Accessibility Guidelines 1.0 checkpoint 6.3 [WAI-WEBCONTENT] : Content developers must ensure that pages are accessible with scripts turned off or in browsers that don't support scripts.

Some techniques to address form submission:

1. Allow the user to configure the user agent. Choices should include:
   - "Never Allow Automatic Submission of Form Content " or "Never Submit {Do Not Prompt}"
   - "Always Allow Automatic Submission of Form Content" or "Always Submit Without Prompting"
   - "Prompt Before Submitting Form Content"

   The default setting should be: "Prompt before submitting form content", so as to allow the user to decide whether or not HTML4 event handling will occur automatically.
2. Configuration can be determined by prompting the user the first time an event handled or script-driven FORM is encountered. Choices should include:
   - "Submit" {optional verbiage: "This Time Only"}
   - "Do Not Submit" {optional verbiage: "This Time Only"}
   - "Always Allow Automatic Submission of Form Content" or "Always Submit Without Prompting"
   - "Never Allow Automatic Submission of Form Content " or "Never Submit {Do Not Prompt}"
   - "Always Prompt Before Submitting Form Content"

   If the user chooses "Prompt Before Submitting Form Content", this prompt could be recycled in an abbreviated fashion. The prompt should include:
   - "Submit This Time Only"
   - "Do Not Submit"
   - "Always Submit and Do Not Ask/Warn Me Again"
   - "Never Submit and Do Not Ask/Warn Me Again"

3.8 Script techniques

Certain elements of the document language may have associated event handlers that are triggered when certain events occur. User agents must be able to identify those elements with event handlers statically associated (i.e., associated in the document source, not in a script).

In HTML

All of the attributes beginning with the prefix "on": "onblur", "onchange", "onclick", "ondblclick", "onkeydown", "onkeypress", "onkeyup", "onload", "onmousedown", "onmousemove", "onmouseout", "onmouseover", "onmouseup", "onreset", "onselect", "onsubmit", and "onunload".

Allow the user to configure the user agent so that mouseover/mouseout events may be triggered by (and trigger) focus/blur events. Similarly, allow the user to use a key command, such as "enter" and "shift-enter" to trigger onclick and ondblclick events.

Implement DOM 2 [DOM2] events with a single activation event and provide a method for triggering that event from each supported input device or input API. These should be the same as the click events and mappings provided above (but note that a user agent which is also an editor may wish to use single click events for moving a system caret, and want to provide a different behavior to activate using the mouse). For example, Amaya [AMAYA] uses a "doAction" command for activating links and form controls, which can be triggered either by the mouse (and it is possible to set it for single-click or double-click) or by the keyboard (it is possible to set it for any key using Amaya's keyboard configuration)

Document the effects of known important scripts to give users an idea in advance of what they do. Make script source available to users so that those familiar with the scripting language may be able to understand their effects.

Note. User agents may already allow users to turn off scripts for security reasons.

3.9 Abbreviations and acronyms

User agents should make available information about abbreviation and acronym expansions. For instance, in HTML, look for abbreviations specified by the ABBR and ACRONYM elements. The expansion may be given with the "title" attribute.

To provide expansion information, user agents may:

- Allow the user to configure that the expansions be used in place of the abbreviations,
- Provide a list of all abbreviations in the document, with their expansions (a generated glossary of sorts)
- Generate a link from an abbreviation to its expansion.
- Allow the user to query the expansion of a selected or input abbreviation.
- If an acronym has no explicit expansion, user agents may look up in a glossary of acronyms for that page for another occurrence. Less reliably, the user agent may look for possible expansions (e.g., in parentheses) in surrounding context.

4 Appendix: Accessibility features of some operating systems

Several of the more popular mainstream operating systems now include a common suite of built-in accessibility features that are designed to assist individuals with varying abilities. Despite operating systems differences, the built-in accessibility features use a similar naming convention and offer similar functionalities, within the limits imposed by each operating system (or particular hardware platform).

The following is a list of built-in accessibility features from several platforms:

StickyKeys
: These allow users to perform a multiple simultaneous key sequence by pressing and releasing each key in sequential order. StickyKeys is designed to work with only those keys defined as modifier keys. Modifier keys are pressed in combination with other keys, to change the outcome of the second (or more) pressed keys. For example, the SHIFT key is defined as a modifier key, since it is commonly used to create upper case characters. Each operating system or hardware platform typically defines a set of keys which can act as modifier keys. The most common modifier keys include SHIFT, CONTROL, and ALTERNATE.

MouseKeys
: These allow users to move the mouse cursor and activate the mouse button(s) from the keyboard.

RepeatKeys
: These allow users to set how fast a key repeats (e.g., sometimes referred to as typematic rate) when the key is held pressed (e.g., Repeat Rate), and also allows control over how quickly the key starts to repeat after the key has been pressed (e.g., delay Until Repeat). Key repeating may also be eliminated.

SlowKeys
: These instruct the computer not to accept a key as pressed until it has been pressed and held down for a specific user adjustable length of time.

BounceKeys
: These prevent extra characters from being typed if the user bounces (e.g., tremor) on the same key when pressing or releasing it.

ToggleKeys
: These provide an audible indication for the status of keys that have a toggled state (e.g., keys that maintain status after being released). The most common toggling keys include Caps Lock, Num Lock, and Scroll Lock.

SoundSentry
: These monitor the operating system and applications for sounds, and attempt to provide a graphical indication when a sound is being played. Older versions of Sound Sentry may have flashed the entire display screen for example, while newer versions of SoundSentry provide the user with a selection of options, such as flashing the active window or flashing the active window caption bar.

The next three built in accessibility features are not as commonly available as the above group of features, but are included here for definition, completeness, and future compatibility.

ShowSounds
: These are user setting or software switches that are available for the operating system and application (including user agents) APIs to read, to notify them that the user wishes audio information to also be presented in a graphical fashion.

High Contrast
: These automatically change the display fonts and colors to choices which should provide for easier reading.

TimeOut
: These allow the built-in accessibility features to automatically turn off if the computer is unused for a specified length of time, and is intended for use when the computer is in a public setting (e.g., library). TimeOut might also be referred to as reset or automatic reset.

The next accessibility feature listed here is not considered to be a built in accessibility feature (since it only provides an alternate input channel) and is presented here only for definition, completeness, and future compatibility.

SerialKeys
: These allow a user to perform all keyboard and mouse functions from an external assistive device (such as communication aid) communicating with the computer via a serial character stream (e.g., serial port, IR port, etc.) rather than or in conjunction with, the keyboard, mouse, and other standard input devices/methods.

Microsoft Windows 95, Windows 98, and Window NT 4.0

For information about Microsoft keyboard configurations (Internet Explorer, Windows 95, Windows 98, and more), refer to documentation on keyboard assistance for Internet Explorer and MS Windows [MS-KEYBOARD] .

The following accessibility features can be adjusted from the Accessibility Options Control Panel:

- StickyKeys: modifier keys include SHIFT, CONTROL, and ALTERNATE.
- FilterKeys: grouping term for SlowKeys, RepeatKeys, and BounceKeys.
- MouseKeys
- ToggleKeys
- SoundSentry
- ShowSounds
- Automatic reset: term used for TimeOut
- High Contrast
- SerialKeys

Additional accessibility features available in Windows 98:

Magnifier
: This is a windowed, screen enlargement and enhancement program used by persons with low vision to magnify an area of the graphical display (e.g., by tracking the text cursor, current focus , etc.). Magnifier can also invert the colors used by the system within the magnification window.

Accessibility Wizard
: This is a setup tool intended to assist a person with making choices which setting up the accessibility features on a workstation.

Apple Macintosh Operating System

The following accessibility features can be adjusted from the Easy Access Control panel (Note: Apple convention uses a space within the accessibility feature names.)

- Sticky Keys: modifier keys include the SHIFT, OPEN APPLE (COMMAND), OPTION (ALT) and CONTROL keys.
- Slow Keys
- Mouse Keys

The following accessibility features can be adjusted from the Keyboard Control Panel.

- Key Repeat Rate (e.g., part of RepeatKeys)
- Delay Unit Repeat (e.g., part of RepeatKeys)

The following accessibility feature can be adjusted from the Sound or Monitors and Sound Control Panel (depends upon which version of the OS).

- Adjusting the volume to off or mute causes the Macintosh to flash the title bar whenever the operating system detects a sound (e.g., SoundSentry)

Additional accessibility features available for the Macintosh OS:

CloseView
: This is a full screen, screen enlargement and enhancement program used by persons with low vision to magnify the information on the graphical display, and it can also change the colors used by the system.

SerialKeys
: This is available as freeware from Apple and several other Web sites.

AccessX, X Keyboard Extension (XKB), and the X Window System

(Note: AccessX became a supported part of the X Window System X Server with the release of the X Keyboard Extension in version X11R6.1)

The following accessibility features can be adjusted from the AccessX graphical user interface X client on some DEC, SUN, and SGI operating systems. Other systems supporting XKB may require the user to manipulate the features via a command line parameter(s).

- StickyKeys: modifier keys are platform-dependent, but usually include the SHIFT, CONTROL, and META keys.
- RepeatKeys:
- SlowKeys:
- BounceKeys:
- MouseKeys:
- ToggleKeys:

DOS (Disk Operating System)

The following accessibility features are available from a freeware program called AccessDOS, which is available from several Internet Web sites including IBM, Microsoft, and the Trace Center, for either PC-DOS or MS-DOS versions 3.3 or higher.

- StickyKeys: modifier keys include the SHIFT, CONTROL, and ALTERNATE keys.
- Keyboard Response Group: grouping term for SlowKeys, RepeatKeys, and BounceKeys
- MouseKeys:
- ToggleKeys:
- SoundSentry (incorrectly name ShowSounds):
- SerialKeys:
- TimeOut:

Testing UA operation with platform standards

Ensure your UA can be operated using the standard interfaces on the target platform(s). People with disabilities should be involved in the design and testing of the software. Some example tests include:

- All user interface components must be keyboard accessible and therefore, must be operable by software or devices that emulate a keyboard. (Use SerialKeys [see Appendix 8] and/or voice recognition software to test keyboard event emulation.) Individuals with varying physical abilities should be able to access your UA using a SerialKeys device or using voice recognition, provided it is keyboard accessible.
- All user interface components must track selection and current focus . Individuals who have low vision and use screen magnification software should

be able to follow highlighted item(s) (e.g., selection), text input location (e.g., sometimes referred to as the "caret"), and any control or component with focus, if your UA exposes these properties correctly.

- All user interface components must provide readable "text" names or labels, even when not visible. Providing this type of information in your UA along with the prior two examples, means that individuals who are blind and accessing your UA using screen reading software and/or a Braille output device should be able to operate and navigate within it.
- All user interface components which convey important information using sound, also need to provide alternate, parallel visual representation of the information for individuals who are deaf, hard of hearing, or operating your UA in a noisy or silent environment where the use of sound isn't practical.
- Establish quality control and assurance processes for consistency of access strategies across software releases.

5 Appendix: Loading assistive technologies for DOM access

There are several methods for developers to accomplish this. Most of these methods fall into four categories:

1. Launch the entire AT inside the address space of the (UA) browser
2. Launch some part of the AT, a piece of stub code, a DLL, a Browser Helper Object [special DLL], etc., inside the address space of the (UA) browser
3. Write your own combined UA/AT (e.g., pwWebSpeak)
4. Out-of-process access to the DOM

These methods are ordered as developments within a rapidly changing technology with the most recent advances/methods listed first.

Loading assistive technologies for direct navigation to User Agent DOMs

Note. This method and the method described in the next section are very similar. What differs is the amount of, or capability of, the AT that actually gets loaded in the same process or address space as the User Agent.)

Access to application specific data across process boundaries might be costly in terms of performance. Therefore, user agents may wish to provide a mechanism to load the entire assistive technology (AT), into the process space of the application as a separate thread with direct access to the DOM.

Determining the Assistive Technologies to load

One technique is to store a reference to an assistive technology in a system registry file or, in the case of Jave, a properties file. Registry files are common among many operating system platforms.

In Windows you have the system registry file. On OS/2 you have the `system.ini` file and on distributed network client networks you often have a system registry server that an application running on the network client computer can query.

In Java 2, the existence of an "accessibility.properties" file causes the system event queue to examine the file for assistive technologies required for loading. If the file contains a property called "assistive_technologies", it will load all registered assistive technologies and start them on their own thread in the Java Virtual Machine that is a single process. An example entry for Java is as follows:

```
assistive_technologies=com.ibm.sns.svk.AccessEngine
```

In Windows, a similar technique could be followed by storing the name of a Dynamic Link Library (DLL) for an assistive technology in a designated assistive technology key name, AT pair. An example entry for Windows could be as follows:

```
HKEY_LOCAL_MACHINE\Software\Accessibility\DOM
       "ScreenReader, VoiceNavigation"
```

Attaching the Assistive Technologies to the DOM.

Once the assistive technology is determined from the registry, any user agent on the given operating system can now determine if an assistive technology needs to be loaded with their application and load it.

On a non-Java platform, a technique to do this would be to create a separate thread with a reference to the User Agent's DOM using a Dynamic Link Library (DLL). This new thread will load the DLL and call a specified DLL entry name with a pointer to the DOM interface. The assistive technology's task will then run until such time as is necessary to end communication with the DOM.

Once loaded, the assistive technology can monitor the DOM as needed. The assistive technology has the option of communicating with a main assistive technology of its own and process the DOM as a caching mechanism for the main AT application or be used as a bridge to the DOM for the main assistive technology.

In the future, it will be necessary to provide a more comprehensive reference to the application that not only provides direct navigation to it's client area DOM, but also multiple DOM's that it is processing and an event model for monitoring them.

Example Technique: Java's Direct Access

Java is a working example where the direct access to application components is executed in a timely manner. Here, an assistive technology running on a separate thread monitors GUI events such as focus changes. Focus changes give the AT notification of which component object has focus. The AT can communicate directly

with all components in the application by walking the parent/child hierarchy and connecting to each component's methods and monitor events directly. In this case an AT has direct access to component specific methods as well as those provided for by the Java Accessibility API. There is no reason that a DOM interface to UA components could not be provided

In Java 1.1.x, Sun's Java access utilities load an assistive by monitoring the Java awt.properties file for the presence of assistive technologies and loads them as shown in the following code example:

```
import java.awt.*;
import java.util.*;

String atNames = Toolkit.getProperty("AWT.assistive_technologies",null);
if (atNames != null) {
    StringTokenizer parser = new StringTokenizer(atNames," ,");
    String atName;
    while (parser.hasMoreTokens()) {
       atName = parser.nextToken();
       try {
          Class.forName(atName).newInstance();
       }
       catch (ClassNotFoundException e) {
          throw new AWTError("Assistive Technology not found: " + atName);
       }
       catch (InstantiationException e) {
          throw new AWTError("Could not instantiate Assistive" +
                             " Technology: " + atName);
       }
       catch (IllegalAccessException e) {
          throw new AWTError("Could not access Assistive" +
                             " Technology: " + atName);
       } catch (Exception e) {
          throw new AWTError("Error trying to install Assistive" +
                             " Technology: " + atName + " " + e);
       }
    }
}
```

In the above code example, the function Class.forName(atName).newInstance() creates a new instance of the assistive technology. The constructor for the assistive technology will then be responsible for monitoring application component objects by monitoring system events.

In the following code example, the constructor for the assistive technology "Access Engine," adds a focus change listener using Java accessibility utilities. When the assistive technology is notified of an objects gaining focus it has direct access to that object. If the Object, o, implemented a DOM interface the assistive technology would now have direct access to the DOM in the same process space as the application.

```
import java.awt.*;
import javax.accessibility.*;
import com.sun.java.accessibility.util.*;
import java.awt.event.FocusListener;
```

```
class AccessEngine implements FocusListener {
   public AccessEngine() {
      //Add the AccessEngine as a focus change listener
      SwingEventMonitor.addFocusListener((FocusListener)this);
   }

   public void focusGained(FocusEvent theEvent) {
      // get the component object source
      Object o = theEvent.getSource();
      // check to see if this is a DOM component
      if (o instanceof DOM) {
         ...
      }
   }
   public void focusLost(FocusEvent theEvent) {
      // Do Nothing
   }
}
```

In this example, the assistive technology has the option of running standalone or acting as a cache for a bridge that communicates with a main assistive technology running outside the Java virtual machine.

Loading part of the assistive technologies for direct access to User Agent DOMs

Access to application specific data across process boundaries might be costly in terms of performance. Therefore, user agents may wish to provide a mechanism to load part of the assistive technology (AT) into the process space of the application as a separate thread, with direct access to the DOM, to provide the specific functionality they require. This could consist of a piece of stub code, a DLL, a Browser Helper Object, etc. An example of how to do this follows.

Browser Helper Objects

In order to attach to a running instance of Internet Explorer 4.0, you can use a "Browser Helper Object." A "Browser Helper Object" is a DLL that will attach itself to every new instance of Internet Explorer 4.0 (only if you explicitly run iexplore.exe). You can use this feature to gain access to the object model of a particular running instance of Internet Explorer. You can also use this feature to get events from an instance of Internet Explorer 4.0. This can be tremendously helpful when many method calls need to be made to IE, as each call will be executed much more quickly than the out of process case.

There are some requirements when creating a Browser Helper Object

- The application that you create must be an in-proc server (that is, DLL).
- This DLL must implement IObjectWithSite.
- The IObjectWithSite::SetSite() method must be implemented. It is through this method that your application receives a pointer to Internet Explorer's IUnknown. (Internet Explorer actually passes a pointer to IWebBrowser2 but the

implementation of SetSite() receives a pointer to IUnknown.) You can use this IUnknown pointer to automate Internet Explorer or to sink events from Internet Explorer.
- It must be registered as a Browser Helper Object as described above.

For more information, please check out:
http://support.microsoft.com/support/kb/articles/Q179/2/30.asp.
http://msdn.microsoft.com/library/techart/bho.htm

Java Access Bridge

In order for native Windows ATs to gain access to Java applications without the creating a Java native solution Sun Microsystems provides the "Java Access Bridge." This bridge is loaded as an AT as described in section 6.1.3. The bridge uses a Java Native Invocation (JNI) to Dynamic Link Library) (DLL) communication and caching mechanism that allows a native assistive technology to gather and monitor accessibility information in the Java environment. In this environment, the AT determines that a Java application or applet is running and communicates with the Java Access Bridge DLL to process accessibility information about the application/applet running in the Java Virtual Machine.

Loading assistive technologies "as" the User Agent with access to the DOMs

Specialized user agents might also include the necessary assistive technology as part of their interface, and thus provide possibly the best of both worlds. An example would be pwWebSpeak, from The Productivity Works [PRODWORKS] .

Loading assistive technologies for indirect access to User Agent DOMs

Access to application specific data across process boundaries or address space might be costly in terms of performance. However, there are other reasons to consider when accessing the User Agent DOM that might lead a developer to wish to access the DOM from their own process or memory address space. One obvious protection this method provides, is that if the User Agent application fails, it doesn't disable the user's AT as well. Another consideration would be legacy systems, where the user relies on their AT for access to other applications as well as the User Agent, and thus would have their AT loaded all the time, not just for accessing the User Agent.

There are several ways to gain access to the User Agent's DOM. Most User Agents support some kind of external interface, or act as a mini-server to other applications running on the desktop. Internet Explorer is a good example of this, as IE can behave as a component object model (COM) server to other applications. Mozilla, the open source release of Navigator also supports cross platform COM (XPCOM).

An example of using COM to access the IE Object Model can be seen in the code snippet below. This is an example of how to use COM to get a pointer to the WebBrowser2 module, which in turn allows you to get a interface/pointer to the document object, or IE DOM for the Web page in view.

```
/* first, get a pointer to the WebBrowser2 control */
if (m_pIE == NULL) {
   hr = CoCreateInstance(CLSID_InternetExplorer,
        NULL, CLSCTX_LOCAL_SERVER, IID_IWebBrowser2,
        (void**)&m_pIE);

   /* next, get a interface/pointer to the document in view,
      this is an interface to the document object model (DOM)*/

   void CHelpdbDlg::Digest_Document() {
      HRESULT hr;
      if (m_pIE != NULL) {
         IDispatch* pDisp;
         hr = m_pIE->QueryInterface(IID_IDispatch, (void**) &pDisp);
         if (SUCCEEDED(hr)) {

            IDispatch* lDisp;
            hr = m_pIE->get_Document(&lDisp);
            if (SUCCEEDED(hr)) {

                IHTMLDocument2* pHTMLDocument2;
                hr = lDisp->QueryInterface(IID_IHTMLDocument2,
                           (void**) &pHTMLDocument2);
                if (SUCCEEDED(hr)) {

                /* with this interface/pointer, IHTMLDocument2*,
                   you can then work on the document */
                   IHTMLElementCollection* pColl;
                   hr = pHTMLDocument2->get_all(&pColl);
                   if (SUCCEEDED(hr)) {

                      LONG c_elem;
                      hr = pColl->get_length(&c_elem);
                      if (SUCCEEDED(hr)) {
                         FindElements(c_elem, pColl);
                      }
                      pColl->Release();
                   }
                   pHTMLDocument2->Release();
                }
                lDisp->Release();
            }
            pDisp->Release();
         }
      }
   }
}
```

For more information on using COM with IE, please visit the Microsoft Web site:http://www.microsoft.com/com/default.asp

For more information on using XPCOM with Mozilla, please visit the Mozilla Web site: http://www.mozilla.org/

For a working example of the method described in 6.1.4, please visit the following web site and review HelpDB, developed as a testing tool for Web table navigation: http://trace.wisc.edu/world/web/document_access/

6 Appendix: Assistive Technology Functionalities

This informative appendix describes some functionalities for assistive technologies to promote accessibility.

Navigation

- Allow users to navigate up/down and among the cells of a table (e.g., by using the focus to designate a selected table cell).
- Refer to the section on table navigation .

Orientation

1. Indicate the row and column dimensions of a selected table. **Note.** User agents should consider multidimensional tables, headers and footers, and multiple header levels.
2. Describe a selected element's position within larger structures (e.g., numerical or relative position in a document, table, list, etc.). For example: tenth link of fifty links; document header 3.4; list one of two, item 4.5; third table, three rows and four columns; current cell in third row, fourth column; etc. Allow users to get this information on demand (e.g., through a keyboard shortcut). Provide this information on the status line on demand from the user.
3. Provide information about form structure and navigation (e.g., groups of controls, control labels, navigation order, and keyboard configuration). For instance, provide information about controls with explicitly associated labels (the "for" attribute of LABEL in HTML), about which keys activate the form controls (the "accesskey" attribute in HTML), about the sequential navigation order of the form controls (the"tabindex" attribute in HTML), and about control groups (the FIELDSET and OPTGROUP elements in HTML). Refer also to checkpoint 1.3 and checkpoint 7.3.
4. Enable announcing of information regarding title, value, grouping, type, status and position of specific focused elements.

Metadata

Metadata of all sorts: titles, dimensions, dates, relationships, etc. promotes accessibility by providing additional context to users. Text metadata is particularly useful since it can be rendered graphically , as Braille, and as speech.

- For information about elements and attributes that convey metadata in HTML, refer to the index of elements and attributes in "Techniques for Web Content Accessibility Guidelines 1.0" [WAI-WEBCONTENT-TECHS] .
- For information about elements and attributes that convey metadata in SMIL, refer to the index of attributes in the W3C Note "Accessibility Features of SMIL" [SMIL-ACCESS] .
- With CSS 2, authors can generate content with the ':before' and ':after' pseudo-elements ([CSS2] , section 5.12.3). For more information, refer to the W3C Note "Accessibility Features of CSS" [CSS-ACCESS] .

One useful form of metadata is content summary information. Provide information, for example, about the number of links, forms, tables, images, significant words, etc.

For example, this information will help a user get an impression about the purpose of each frame in a frameset. For example, if the content of a frame has many links, but few significant words, then the frame is probably an index of some kind. Content with many significant words is probably a text page. Content with only a couple of pictures and few significant words or links is probably for decoration.

Synthesized speech

Tools that work with synthesized speech do not always pronounce text correctly. Therefore, they should provide additional context so that users can understand content. Techniques include:

- Spelling words
- Indicating punctuation, capitalization, etc.
- Allowing users to reply words alone and in context.
- Using auditory nuances - including pitch, articulation model, volume, and orientation - to convey meaning the way fonts, spacing, and borders do in graphical media.
- Generating context. For example, a user agent might speak the word "link" before a link, "header" before the text content of a header or "item 1.4" before a list item.
- Rendering text according in the appropriate natural language .

Refer to "Speak to Write" [SPEAK2WRITE] for information on speech recognition and accessibility.

Rendering content according to natural language

Assistive technologies may recognize different natural languages and can render content according to language markup defined for a certain part of the document. For instance, a screen reader might change the pronunciation of spoken text according to the language definition. This is usually desired and done according to the capabilities of the tool. Some specialized tools might give some finer user control for the pronunciation as well.

Natural language may be identified by markup (e.g., the "lang" attribute in HTML 4.0 ([HTML40] section 8.1) or "xml:lang" in XML 1.0 ([XML] , section 2.12), or by the HTTP Content-Language header ([RFC2616] , section 14.12). HTML and XML are available through DOM Level 1 [DOM1] . Refer to checkpoint 2.7 and checkpoint 5.2.

Note. A user agent may not support all languages.

7 Appendix: Glossary

Active element

Active elements have associated behaviors that may be ***activated*** (or "triggered") either through user interaction or through scripts. Which elements are active depends on the document language and whether the features are supported by the user agent. In HTML documents, for example, active elements include links, image maps, form controls, element instances with a value for the "longdesc" attribute, and element instances with scripts (event handlers) explicitly associated with them (e.g., through the various "on" attributes).
An active element's behavior may be triggered through any number of mechanisms, including the mouse, keyboard, an API, etc. The effect of activation depends on the element. For instance, when a link is activated, the user agent generally retrieves the linked resource. When a form control is activated, it may change state (e.g., check boxes) or may take user input (e.g., a text field). Activating an element with a script assigned for that particular activation mechanism (e.g., mouse down event, key press event, etc.) causes the script to be executed.
Most systems use the content focus to navigate active elements and identify which is to be activated.

Alternative Equivalents for Content

Since rendered content in some forms is not always accessible to users with disabilities, authors must supply alternative equivalents for content. In the context of this document, the equivalent must fulfill essentially the same function for the person with a disability (at least insofar as is feasible, given the nature of the disability and the state of technology), as the "primary" content does for the person without any disability. For example, the text "The Full Moon" might convey the same information as an image of a full moon when presented to users. Note that equivalent information focuses on fulfilling the same function. If the image is part of a link and understanding the image is crucial to guessing the link target, an equivalent must also give users an idea of the link target.
Alternative equivalents of content include ***text equivalents*** (long and short, synchronized and unsynchronized) and non-text equivalents (e.g., captions , auditory descriptions , a visual track that shows sign language translation of a written text, etc.). The Techniques Document [UA-TECHNIQUES] describes the different mechanisms authors use to supply alternative equivalents for content.
Please also consult the Web Content Accessibility Guidelines [WAI-WEBCONTENT] and its associated Techniques document [WAI-WEBCONTENT-TECHS] .

Application Programming Interface (API)

An application programming interface (API) defines how communication may take place between applications.

Assistive Technology

In the context of this document, an assistive technology is a user agent that relies on one or more other user agents to help people with disabilities interact with a computer. For example, screen reader software is an assistive

technology because it relies on browsers or other application software to enable Web access, notably for people with visual and learning disabilities.

Examples of assistive technologies that are important in the context of this document include the following:

- screen magnifiers, which are used by people with visual disabilities to enlarge and change colors on the screen to improve the visual readability of text and images.
- screen readers, which are used by people who are blind or have reading disabilities to read textual information through synthesized speech or Braille displays.
- alternative keyboards, which are used by people with certain physical disabilities to simulate the keyboard.
- alternative pointing devices, which are used by people with certain physical disabilities to simulate mouse pointing and button activations.

Beyond this document, an assistive technology consists of software or hardware that has been specifically designed to assist people with disabilities in carrying out daily activities, e.g., wheelchairs, reading machines, devices for grasping, alternative computer keyboards or pointing devices, etc.

Auditory Description

An auditory description is either a prerecorded human voice or a synthesized voice (recorded or generated on the fly) describing the key visual elements of a presentation. The auditory description is synchronized with the auditory track of the presentation, usually during natural pauses in the auditory track. Auditory descriptions include information about actions, body language, graphics, and scene changes.

Author Styles

Style property values that originate in documents, their associated style sheets, or come from a server are called author styles.

Captions

Captions (or sometimes "closed captions") are text transcripts that are synchronized with other auditory or visual tracks. Captions convey information about spoken words and non-spoken sounds such as sound effects. They benefit people who are deaf and hard-of-hearing, and anyone who cannot hear the audio (e.g., when in a noisy room). Captions are generally rendered graphically above, below, or superimposed over video. **Note.** Other terms that include the word "caption" may have different meanings in this document. For instance, a "table caption" is a title for the table, often positioned graphically above or below the table. In this document, the intended meaning of "caption" will be clear from context.

Configure

To set user preferences. This may be done through the user agent's user interface , through configuration files, by scripts, etc.

Control

In the context of this document, "user control" of the user agent (e.g., its interface, behavior, and styles) means that the user can choose preferred

behavior from a set of options. For instance, control of colors means that the user can choose from a set of available colors.

The term "control" also means "user interface component" or "form component" in this document. Which meaning is intended will be apparent from context.

Device-independence

The ability to make use of software via any input or output device API provided by the operating system and used by the user agent. User agents should follow operating system conventions and use standard APIs for device input and output.

Documentation

Documentation includes **all** product documentation, notably installation instructions, the help system, and all product manuals.

Documents, Elements, and Attributes

A document may be seen as a hierarchy of elements. ***Element*** types are defined by a language specification (e.g., HTML 4.0 or an XML application). Elements may include content (that may be rendered) and make have ***attributes*** that take values (and may also be rendered).

Events and scripting, Event Handler

When certain events occur (loading or unloading events, mouse press or hover events, keyboard events, etc.), user agents often perform some task (e.g., execute a script). For instance, in most user agents, when a mouse button is released over a link, the link is activated and the linked resource retrieved. User agents may also execute author-defined scripts when certain events occur. The script bound to a particular event is called an ***event handler***. **Note.** The interaction of HTML, style sheets, the Document Object Model ([DOM1] , [DOM2]), and scripting is commonly referred to as "Dynamic HTML" or DHTML. However, as there is no W3C specification that formally defines DHTML, this document only refers to event handlers and scripts.

Focus, ***Content focus***, ***User interface focus***, ***Current focus***

The term "focus" refers to two identifying mechanisms of user agents:

1. The "content focus" designates an active element in a document. A viewport has at most one content focus.
2. The "user interface focus" designates a control of the user interface that will respond to user input (e.g., a radio button, text box, menu, etc.).

The term "focus" encompasses both types of focus. Where one is meant specifically in this document, it is identified.

When several viewports co-exist, each may have a content and user interface focus. At all times, only one content focus **or** one user interface focus is active, called the current focus. The current focus responds to user input. The current may be toggled between content focus and user interface focus through the keyboard, pointing device, etc. Both the content and user interface focus may be highlighted .

Graphical

In this document, the term "graphical" refers to information (text, graphics, colors, etc.) rendered for visual consumption.

Highlight

Any mechanism used to emphasize selected or focused content. For example, graphical highlight mechanisms include dotted boxes, underlining, and reverse video. Synthesized speech highlight mechanisms include altered voice pitch or volume.

Input Configuration

Every user agent functionality available to the user is mapped to some user interface mechanism such as menus, buttons, keyboard shortcuts, voice commands. The default input configuration is the mapping the user finds after installation of the software; it must be part of the user agent documentation .

Native support

A user agent supports a feature natively if it does not require another piece of software (e.g., plug-in or external program) for support. Operating system features adopted as part of the user agent are considered native. However, since the user agent is responsible for the accessibility of native features, it is also considered responsible for the accessibility of adopted operating system features.

Natural Language

Spoken, written, or signed human languages such as French, Japanese, and American Sign Language. The natural language of content may be indicated in markup (e.g., by the "lang" attribute in HTML 4.0 ([HTML40] section 8.1), the HTML 4.0 "hreflang" attribute for links ([HTML40] , section 12.1.5), or by the HTTP Content-Language header ([RFC2616] , section 14.12).

Point of Regard

The "point of regard" is the position of the viewport in content. Since users may be viewing content with browsers that render graphically , as speech, as Braille, etc., what is meant precisely by "the point of regard" may vary. It may, depending on the user agent and browsing context, refer to a two dimensional area (e.g., for graphical rendering) or a single point (e.g., for aural rendering or voice browsing). User agents should not change the point of regard unexpectedly as this can disorient users.

Properties, Values, and Defaults

A user agent renders a document by applying formatting algorithms and style information to the document's elements. Formatting depends on a number of factors, including where the document is rendered: on screen, on paper, through speakers, on a Braille device, on a mobile device, etc. Style information (e.g., fonts, colors, voice inflection, etc.) may come from the elements themselves (e.g., certain style attributes in HTML), from style sheets, or from user agent settings. For the purposes of these guidelines, each formatting or style option is governed by a ***property*** and each property may take one value from a set of legal values. (The term "property" in this document is used as defined in CSS 2 ([CSS2] , section 3). A reference to "styles" in this document means a set of style-related properties.

The value given to a property by a user agent when it is installed is called the property's ***default value***.

Profile

A "profile" is a named and persistent representation of user preferences that may be used to configure a user agent. On systems with distinct user accounts, profiles enable users to reconfigure software quickly when they log on. Profiles may be shared with other users. Platform-independent profiles are useful for those who use the same user agent on different platforms.

Recognize

A user agent is said to recognize markup, content types, or rendering effects when it can identify (through built-in mechanisms, Document Type Definitions (DTDs) style sheets, headers, etc) the information. For instance, HTML 3.2 user agents may not recognize the new elements or attributes of HTML 4.0. Similarly, a user agent may recognize blinking content specified by elements or attributes, but may not recognize that an applet is blinking. The Techniques Document [UA-TECHNIQUES] lists some markup known to affect accessibility.

Rendered content

An element's rendered content is that which a user agent renders for the element. This may be what appears between the element's start and end tags, the value of an attribute (c.f. the "alt", "title", and "longdesc" attributes in HTML), or external data (e.g., the IMG element in HTML). Content may be rendered to a graphical display, to an auditory display (to a speaker as speech and non-speech sounds) or to a tactile display (Braille and haptic displays). Refer also to the description of alternative equivalents for content.

Selection, ***Current Selection***

The "selection" generally identifies a range of content (text, images, etc.) in a document. The selection may be structured (based on the document tree) or unstructured (e.g., text-based). Content may be selected through user interaction, scripts, etc. The selection may be used for a variety of purposes: for cut and paste operations, to designate a specific element in a document, to identify what a screen reader should read, etc.

The selection may be set by the user (e.g., by a pointing device or the keyboard) or through an application programming interface (API). A viewport has at most one selection (though the selection may be rendered graphically as discontinuous text fragments). When several viewports co-exist, each may have a selection, but only one is active, called the current selection.

On the screen, the selection may be highlighted using colors, fonts, graphics, or other assistive technologies may provide alternative presentation of the selection through speech, enlargement, or refreshable Braille display.

Text transcript

A text transcript is a text equivalent of audio information (e.g., an auditory track). It provides text for both spoken words and non-spoken sounds such as sound effects. Text transcripts make presentations accessible to people who are deaf-blind (they may be rendered as Braille) and to people who cannot play movies, animations, etc. Transcripts may be generated on the fly (e.g., by speech-to-text converters). Refer also to captions .

Spawned Viewport

Viewports that are created by the user agent. This refers to viewports that

display content and does not include, for example, messages or prompts to the user.

Standard Device Application Programming Interfaces

Operating systems are designed to be used by default with devices such as pointing devices, keyboards, voice input, etc. The operating system (or windowing system) provides "standard APIs " for these devices. On desktop computers today, the standard input APIs are for the mouse and keyboard. For touch screen devices or mobile devices, standard input APIs may include stylus, buttons, voice, etc. The display and sound card are considered standard ouput devices for a graphical desktop computer environment and each has a standard API.

User-initiated, User Agent initiated

User-initiated actions result from user input to the user agent. User agent initiated actions result from scripts, operating system conditions, or built-in user agent behavior.

User Agent

A user agent is an application that retrieves and renders Web content, including text, graphics, sounds, video, images, and other objects. A user agent may require additional user agents that handle some types of content. For instance, a browser may run a separate program or plug-in to render sound or video. User agents include graphical desktop browsers, multimedia players, text browsers, voice browsers, and assistive technologies such as screen readers, screen magnifiers, speech synthesizers, onscreen keyboards, and voice input software.

User Interface

For the purposes of this document, "user interface" includes both:

1. the "***user agent user interface***", i.e., the controls and mechanisms offered by the user agent for user interaction, such as menus, buttons, keyboard access, etc.
2. the "***content user interface***", i.e., the active elements that are part of content, such as form controls, links, applets, etc. that are implemented natively .

The document distinguishes them only where required for clarity.

User Styles

Style property values that come from user interface settings, user style sheets, or other user interactions are called user styles.

Views, Viewports, and Current View

User agents may handle different types of source information: documents, sound objects, video objects, etc. The user perceives the information through a ***viewport***, which may be a window, a frame, a piece of paper, a speaker, a virtual magnifying glass, etc. A viewport may contain another viewport (e.g., nested frames).

User agents may render the same content in a variety of ways; each rendering is called a ***view***. For instance, a user agent may allow users to view an entire document or just a list of the document’s headers. These are two different views of the document.

The view corresponds to *how* source information is rendered and the viewport is

where it is rendered. The viewport that contains both the current focus and the current selection is called the ***current viewport***. The current viewport is generally highlighted when several viewports co-exist.
Generally, viewports give users access to all rendered information, though not always at once. For example, a video player shows a certain number of frames per second, but allows the user to rewind and fast forward. A graphical browser viewport generally features scrollbars or some other paging mechanism that allows the user to bring the rendered content into the viewport.

8 Acknowledgments

Many thanks to the following people who have contributed through review and comment: Paul Adelson, James Allan, Denis Anson, Kitch Barnicle, Harvey Bingham, Olivier Borius, Judy Brewer, Bryan Campbell, Kevin Carey, Wendy Chisholm, David Clark, Chetz Colwell, Wilson Craig, Nir Dagan, Daniel Dardailler, B. K. Delong, Neal Ewers, Geoff Freed, John Gardner, Al Gilman, Larry Goldberg, Glen Gordon, John Grotting, Markku Hakkinen, Eric Hansen, Earle Harrison, Chris Hasser, Kathy Hewitt, Philipp Hoschka, Masayasu Ishikawa, Phill Jenkins, Earl Johnson, Jan Kärrman (for help with html2ps), Leonard Kasday, George Kerscher, Peter Korn, Marja-Riitta Koivunen, Josh Krieger, Catherine Laws, Greg Lowney, Scott Luebking, William Loughborough, Napoleon Maou, Charles McCathieNevile, Peter Meijer, Karen Moses, Masafumi Nakane, Mark Novak, Charles Oppermann, Mike Paciello, David Pawson, Michael Pederson, Helen Petrie, David Poehlman, Michael Pieper, Jan Richards, Hans Riesebos, Joe Roeder, Lakespur L. Roca, Gregory Rosmaita, Madeleine Rothberg, Lloyd Rutledge, Liam Quinn, T.V. Raman, Robert Savellis, Rich Schwerdtfeger, Constantine Stephanidis, Jim Thatcher, Jutta Treviranus, Claus Thogersen, Steve Tyler, Gregg Vanderheiden, Jaap van Lelieveld, Jon S. von Tetzchner, Willie Walker, Ben Weiss, Evan Wies, Chris Wilson, Henk Wittingen, and Tom Wlodkowski,

9 References

For the latest version of any W3C specification, please consult the list of W3C Technical Reports.

[CHARMOD]
"Character Model for the World Wide Web", M. Dürst, 25 February 1999. This W3C Working Draft is http://www.w3.org/TR/1999/WD-charmod-19990225.

[CSS1]
"CSS, level 1 Recommendation", B. Bos, H. Wium Lie, eds., 17 December 1996, revised 11 January 1999. This CSS1 Recommendation is http://www.w3.org/TR/1999/REC-CSS1-19990111.

[CSS2]
"CSS, level 2 Recommendation", B. Bos, H. Wium Lie, C. Lilley, and I. Jacobs, eds., 12 May 1998. This CSS2 Recommendation is http://www.w3.org/TR/1998/REC-CSS2-19980512.

[CSS-ACCESS]
"Accessibility Features of CSS", I. Jacobs, J. Brewer, The latest version of this W3C Note is available at http://www.w3.org/TR/CSS-access.

[DOM1]
"Document Object Model (DOM) Level 1 Specification", V. Apparao, S. Byrne, M. Champion, S. Isaacs, I. Jacobs, A. Le Hors, G. Nicol, J. Robie, R. Sutor, C. Wilson, and L. Wood, eds. The 1 October 1998 DOM Level 1 Recommendation is http://www.w3.org/TR/1998/REC-DOM-Level-1-19981001

[DOM2]
"Document Object Model (DOM) Level 2 Specification", L. Wood, A. Le Hors, V. Apparao, L. Cable, M. Champion, J. Kesselman, P. Le Hégaret, T. Pixley, J. Robie, P. Sharpe, C. Wilson, eds. The DOM2 specification is a Working Draft at the time of publication.

[HTML40]
"HTML 4.0 Recommendation", D. Raggett, A. Le Hors, and I. Jacobs, eds. The 24 April 1998 HTML 4.0 Recommendation is http://www.w3.org/TR/1998/REC-html40-19980424

[MATHML]
"Mathematical Markup Language", P. Ion and R. Miner, eds. The 7 April 1998 MathML 1.0 Recommendation is http://www.w3.org/TR/1998/REC-MathML-19980407

[MICROPAYMENT]
"Common Markup for micropayment per-fee-links", T. Michel, ed. The latest version of this W3C Working Draft is available at http://www.w3.org/TR/Micropayment-Markup.

[RFC2119]
"Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997.

[RFC2616]
"Hypertext Transfer Protocol -- HTTP/1.1, J. Gettys, J. Mogul, H. Frystyk, L.

Masinter, P. Leach, T. Berners-Lee, June 1999.

[SMIL]
"Synchronized Multimedia Integration Language (SMIL) 1.0 Specification", P. Hoschka, editor. The 15 June 1998 SMIL 1.0 Recommendation is http://www.w3.org/TR/1998/REC-smil-19980615

[SMIL-ACCESS]
"Accessibility Features of SMIL", M-R. Koivunen, I. Jacobs. The latest version of this W3C Note is available at http://www.w3.org/TR/SMIL-access.

[UA-CHECKLIST]
An appendix to this document lists all of the checkpoints, sorted by priority. The checklist is available in either tabular form (at http://www.w3.org/WAI/UA/WD-UAAG-20000115/full-checklist) or list form (at http://www.w3.org/WAI/UA/WD-UAAG-20000115/checkpoint-list).

[UA-TECHNIQUES]
"Techniques for User Agent Accessibility Guidelines 1.0", J. Gunderson, I. Jacobs, eds. This document explains how to implement the checkpoints defined in "User Agent Accessibility Guidelines 1.0". The draft of the Techniques Document available at the time of this document's publication is http://www.w3.org/WAI/UA/WD-UAAG-TECHS-20000115. The latest draft of the techniques is available at http://www.w3.org/WAI/UA/UAAG-TECHS/

[WAI-AUTOOLS]
"Authoring Tool Accessibility Guidelines", J. Treviranus, J. Richards, I. Jacobs, C. McCathieNevile, eds. The latest Working Draft of these guidelines for designing accessible authoring tools is available at http://www.w3.org/TR/WD-WAI-AUTOOLS/

[WAI-WEBCONTENT]
"Web Content Accessibility Guidelines 1.0", W. Chisholm, G. Vanderheiden, and I. Jacobs, eds. The 5 May 1999 Recommendation is http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505

[WAI-WEBCONTENT-TECHS]
"Techniques for Web Content Accessibility Guidelines 1.0", W. Chisholm, G. Vanderheiden, and I. Jacobs, eds. The latest version of this document is available at http://www.w3.org/TR/WAI-WEBCONTENT-TECHS

[WAI-WEBCONTENT-ERT]
"Techniques For Evaluation And Implementation Of Web Content Accessibility Guidelines, C. Ridpath. The latest version of this Working Draft is available at http://www.w3.org/WAI/ER/IG/ert/.

[XML]
"Extensible Markup Language (XML) 1.0.", T. Bray, J. Paoli, C.M. Sperberg-McQueen, eds. The 10 February 1998 XML 1.0 Recommendation is http://www.w3.org/TR/1998/REC-xml-19980210

[XSLT]
"XSL Transformations (XSLT) Version 1.0", J. Clark. The 16 November 1999 Recommendation is http://www.w3.org/TR/1999/REC-xslt-19991116.

10 Services

Note. *W3C does not guarantee stability for any of the following references outside of its control. These references are included for convenience.*

[ALTIFIER]
The Altifier Tool for generates "alt" text intelligently.
[AMAYA]
Amaya is W3C's testbed browser/editor.
[APPLE-HI]
Information on accessibility guidelines for Macintosh applications. Information on Apple's scripting model can be found at tn1095 and tn1164. Refer also to the Inside Macintosh chapter devoted to Interapplication Communication.
[AUI]
"Auditory user interfaces : toward the speaking computer", T.V. Raman, Kluwer Academic Publishers, 1997.
[BHO]
Browser Helper Objects: The Browser the Way You Want It, D. Esposito, January 1999.
[BRAILLEFORMATS]
"Braille Formats: Principles of Print to Braille Transcription 1997".
[CCPP]
Composite Capability/Preference Profiles (CC/PP): A user side framework for content negotiation, F. Reynolds, J. Hjelm, S. Dawkins, and S. Singhal, eds. This W3C Note describes a general yet extensible framework for describing user preferences and device capabilities. The latest version is available at http://www.w3.org/TR/NOTE-CCPP/.
[ED-DEPT]
"Requirements for Accessible Software Design", US Department of Education, version 1.1 March 6, 1997.
[EITAAC]
"EITAAC Desktop Software standards", Electronic Information Technology Access Advisory (EITAAC) Committee.
[IBM-ACCESS]
"Software Accessibility" IBM Special Needs Systems.
[ICCCM]
"The Inter-Client communication conventions manual". A protocol for communication between clients in the X Window system.
[ICE-RAP]
"An ICE Rendezvous Mechanism for X Window System Clients", W. Walker. A description of how to use the ICE and RAP protocols for X Window clients.
[ISO639]
"Codes for the representation of names of languages", ISO 639:1988. For more information, consult http://www.iso.ch/cate/d4766.html. Refer also to http://www.oasis-open.org/cover/iso639a.html.

[JAVA-ACCESS]
"IBM Guidelines for Writing Accessible Applications Using 100% Pure Java", R. Schwerdtfeger, IBM Special Needs Systems.

[JAVAAPI]
Information on Java Accessibility API can be found at Java Accessibility Utilities.

[JAVA-CHECKLIST]
"Java Accessibility Guidelines and Checklist". IBM Special Needs Systems.

[JAVA-TUT]
"The Java Tutorial. Trail: Creating a GUI with JFC/Swing". An online tutorial that describes how to use the Swing Java Foundation Class to build an accessible User Interface.

[LYNX]
The Lynx Browser.

[MSAA]
Information on active accessibility can be found at the Microsoft WWW site on Active Accessibility.

[MS-ENABLE]
Information on accessibility guidelines for Windows applications.

[MS-KEYBOARD]
Information on keyboard assistance for Internet Explorer and MS Windows.

[MS-SOFTWARE]
"The Microsoft Windows Guidelines for Accessible Software Design". **Note.** This page summarizes the guidelines and includes links to the full guidelines in various formats (including plain text).

[NISO]
National Information Standards Organization. One activity pursued by this organization concerns Digital Talking Books. Refer to the "Digital Talking Book Features List" draft for more information.

[NOTES-ACCESS]
"Lotus Notes Accessibility Guidelines" IBM Special Needs Systems.

[PRODWORKS]
The Productivity Works.

[SPEAK2WRITE]
Speak to Write is a site about using speech recognition to promote accessibility.

[SUN-DESIGN]
"Designing for Accessibility", Eric Bergman and Earl Johnson. This paper discusses specific disabilities including those related to hearing, vision, and cognitive function.

[SUN-HCI]
"Towards Accessible Human-Computer Interaction", Eric Bergman, Earl Johnson, Sun Microsytems 1995. A substantial paper, with a valuable print bibliography.

[TRACE-REF]
"Application Software Design Guidelines" compiled by G. Vanderheiden. A thorough reference work.

[UNICODE]
The Unicode Consortium. "The Unicode Standard, Version 3.0", Reading, MA, Addison-Wesley Developers Press, 2000. ISBN 0-201-61633-5. Refer also to http://www.unicode.org/unicode/standard/versions/.

[USERAGENTS]
List of Alternative Web Browsers. This list is maintained by WAI.

[WHAT-IS]
"What is Accessible Software", James W. Thatcher, Ph.D., IBM, 1997. This paper gives a short example-based introduction to the difference between software that is accessible, and software that can be used by some assistive technologies.

[XGUIDELINES]
Information on accessibility guidelines for Unix and X Window applications. The Open Group has various guides that explain the Motif and Common Desktop Environment (CDE) with topics like how users interact with Motif/CDE applications and how to customize these environments. **Note.** In X, the terms client and server are used differently from their use when discussing the Web.