Techniques for User Agent Accessibility Guidelines 1.0

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

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 HTML, CSS and SMIL.

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

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 Members of 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 discussed 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

1 Introduction

1.1 Priorities

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

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

[Priority 2]
: This checkpoint **should** be satisfied by user agents as a native feature, otherwise one or more groups of users will find it difficult to access information. Satisfying this checkpoint will remove significant barriers to accessing Web documents.

[Priority 3]
: This checkpoint **may** be satisfied by user agents as a native feature to make it easier for one or more groups of users to access information. Satisfying this checkpoint will improve access to the Web for some individuals.

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

1.1 Ensure that every functionality offered through the user interface is available through every input device API used by the user agent. User agents are not required to reimplement low-level functionalities (e.g., for character input or pointer motion) that are inherently bound to a particular API and most naturally accomplished with that API. [Priority 1]

Note. The device-independence required by this checkpoint applies to functionalities described by the other checkpoints in this document unless otherwise stated by individual checkpoints. 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:

- Do not communicate 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.
- Do not implement your own input queue handler. Devices for mobility access, such as those that use serial keys, use the standard input queue to control applications.
- 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), ensure that the user can select the text in a device-independent manner, then activate the functionality in a device-independent manner, then interact with any prompts, etc. in a

device-independent manner.

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

For example, do not directly manipulate the memory associated with information being rendered since screen review utilities, which monitor rendering through the standard APIs, will not work properly.

Techniques:

- When writing textual information in GUI operating system use standard text drawing APIs of an operating system, do not create off screen bitmaps and copy them to the display. This allows assistive technologies to capture text and render it as speech or braille.
- Use operating system resources for rendering audio information; do not take exclusive control of system audio resources.
- Enhance the functionality of standard system controls to improve accessibility. For example provide keyboard navigation to menus and dialog box controls in the Apple Macintosh operating system.

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 motor impairments must be able to activate the links in a client-side image map without a pointing device. One technique for doing so is to render client-side image maps as text links. **Note.** This checkpoint is an important special case of checkpoint 1.1.

Techniques:

Refer to checkpoint 1.1 and checkpoint 1.5.

For client-side image maps:

- If alternative text ("alt" or "title" in HTML) is available and not null for the element (like INPUT or IMG in HTML) that points to a client-side map, then render some text indicating a map (like "Start of map") plus the alternative text and the number of areas in the map. If alt text is null, do not render the map or its areas.
- For each AREA in the map, if alternative text ("alt" or "title") is available and not null, then render the alternative text as a link. Otherwise, render some text like "Map area" plus part or all of the href as a link. If alt "text" is null for an AREA, do not render that AREA.
- When reading through the whole Web page, read the start of map alternative text 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.

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

The keystroke-only command protocol of the user interface should be efficient enough to support production use. Functionalities include being able to show, hide, resize and move graphical viewports created by the user agent. **Note.** This checkpoint is an important special case of checkpoint 1.1.

Techniques:

- Ensure that the user can trigger mouseover, mouseout, click, etc. events from the keyboard consistently.
- Ensure that the user can use the graphical user interface menus from the keyboard.
- 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.
- In specialized user agents (i.e. touch screen kiosks, portable devices) with only one input techniques provide an accessible alternative (for example EasyAccess, IR links to assistive technologies)
- Allow the user to activate events associated with an element using the keyboard, including events that imply device dependence like onMouseOver, MouseClick, etc...

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 would flash the screen, as appropriate, in response to events that would cause these sounds to play. This enables the users with deafness to use the application in the absence of sound.

When implementing standard output, do not:

- Render text in the form of 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).
- Provide your own mechanism for generating pre-defined system sounds.
- When using a device do not use the device driver directly. 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.
- Make sure an auditory message also has a redundant visual text message. For example in AOL "You have mail" should also be presented visually.
- Tutorials that use speech to guide a user through the operation of the user agent should also be available at the same time as graphically displayed text.

Guideline 2. Ensure user access to all content

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

Note. Although it is not a requirement that alternative content be available at the same time as primary content, some users may benefit from simultaneous access. For instance, users with low vision may want to view images (even imperfectly) but require alternative text for the image to be rendered in a very large size or as speech.

Techniques:

It is not sufficient to convert a rendering intended for one medium into a rendering for a different medium (e.g., a graphical rendering to speech) since structural information is lost. Examples: table cells, nested lists (want to know where list item ends).

Also, serial access to content not always convenient, so we need additional mechanisms to select and receive content.

Where does content come from?

Some combination of document source, style sheets (which may hide content or generate content), and user agent additions (which may add contextual information or dynamic information such as whether a link has been visited).

In addition, the user agent may want to provide "intelligent" access to content to simplify the view or to convey models more familiar to users than what is conveyed by the DTD alone.

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 alt text instead of images - a lynx-like view. All the views are synchronized for navigation (and for editing).

What does access mean?

Access means that the user agent renders selected content. Content includes text, video, audio, and alternative equivalents to them (which may be attribute values, element content, external resources, etc.).

In the simplest case, the user agent renders the document (e.g., two-dimensional graphical layout, audio stream, line-by-line braille stream) and the user has access to the entire rendering.

But this is not sufficient and so the user agent must provide navigation mechanisms that allow the user to set the selection/focus and then request the selected content (or information about the content - refer to another section...).

User interface issues

- How to indicate what piece of content one wants to access?
- How does the user agent present the information?
- How does the user configure the user agent to present associated contextual information?

Refer to the section on navigation for different navigation techniques (serial, direct, tree, etc.).

Rendering issues:

- If an object with a preferred geometry is specified and not rendered, should the alt content be rendered in the preferred (but empty) region? What if the alternative content 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.
- Should you render inline or in some other view: distinguished or integrated in content?
- Need to be able to distinguish image links from their long descriptions ("longdesc" in HTML).

Structured v. Unstructured selection.

- 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).

Contextual information

In addition to providing information about content, user agents must provide contextual information. Examples: table cell row/column position or header information. Or list item number within nested lists. Contextual information includes language of content as well.

- 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 .
- To provide text equivalents of non-text content:
  - Look for the "alt" attribute (e.g., on IMG in HTML).
  - Look for the "title" attribute
  - If the replaced content is text (e.g., a "text" element in SMIL), use the text content.
- The "Altifier Tool" (refer to [ALTIFIER]) illustrates smart techniques for generating alternative text for images, etc. when the author hasn't supplied any.

Speech-based user agents providing accessible solutions for images should, by default, provide *no* information about images for which the author has provided no alternative text. 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 equivalent. 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 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.

In [HTML40] , alternative content may come from the following sources:

- For the IMG element: The "alt", "title", and "longdesc" attributes.
- For the OBJECT element: The content of the element and the "title" attribute.
- For the APPLET element: The "alt" attribute and the content of the element.
- For the AREA element: The "alt" attribute.
- For the INPUT element: The "alt" attribute.
- For the ACRONYM and ABBR elements: The "title" attribute may be used for the acronym or abbreviation expansion.
- For the TABLE element, the "summary" attribute.
- For frames, the NOFRAMES element and the "longdesc" attribute on FRAME and IFRAME.
- For scripts, the NOSCRIPT element.

2.2 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 tracks of closed closed captions (or subtitles) available (e.g., in different languages, different levels of detail, etc.) allow the user to choose from among them.

2.3 Render content according to natural language identification. [Priority 1]

Natural language may be identified by markup (e.g., the "lang" attribute in HTML [HTML40] or "xml:lang" in [XML]) or HTTP headers. Refer also to checkpoint 2.9 and checkpoint 5.3.

2.4 Provide time-independent access to time-dependent active elements or allow the user to control the timing of changes. [Priority 1]

Techniques:

- Provide time-dependent information in a time-independent manner, such as a static list of links that are time-dependent and occupy the same screen real estate.
- Allow the user to control the timing of changes.
- Allow the user to navigate sequences of related links that vary over time.

2.5 Allow the user to specify that continuous equivalent tracks (e.g., closed captions , auditory descriptions , video of sign language, etc.) be rendered at the same time as audio and video tracks. [Priority 1]
2.6 If a technology allows for more than one audio track, allow the user to choose from among tracks. [Priority 1]
2.7 When no text equivalent has been specified, indicate what type of object is present. [Priority 2]

Techniques:

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

2.8 When alternative text has been specified explicitly as empty (i.e., an empty string), render nothing. [Priority 3]
2.9 For identified but unsupported natural languages, notify the user of language changes when configured to do so. [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 XML ("xml:lang") should be made available through the DOM ([DOM1]).

User agents may announce language changes using style sheets and generating text (refer to [CSS2]) that indicates the change of language.

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

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

Techniques:

- In [CSS1] , background images may be turned on/off with the ’background’ and ’background-image’ properties.

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

Techniques:

- Users sometimes specify background sounds with the "bgsound" attribute. **Note.** This attribute is **not** part of [HTML40] .
- In [CSS2] , background sounds may be turned on/off with the 'play-during', property.

3.3 Allow the user to turn on and off rendering of video. [Priority 1]
3.4 When the user agent renders audio natively, allow the user to turn on and off rendering of audio. [Priority 1]
3.5 Allow the user to turn on and off animated or blinking text. [Priority 1]

Techniques:

- 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:

Render static text 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 in the 4 to 59 flashes per second (Hertz) range. Users should be able, for security reasons, to prevent scripts from executing on their machines.

Techniques:

Refer to the section on script techniques

3.8 Allow the user to turn on and off rendering of images. [Priority 3]
3.9 Allow the user to turn on and off author-specified forwards that occur after a time delay and without user intervention. [Priority 3]

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 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.

For example, when forwarding has been turned off, offer a static link to the target.

3.10 Allow the user to turn on and off automatic content refresh. [Priority 3]
For example, when turned off, allow the user to refresh content manually instead (through the user interface).

Guideline 4. Ensure user control over styles

Checkpoints for fonts and colors:

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

Techniques:

- Implement the CSS ’font-family’ property.

4.2 Allow the user to control the size of text. [Priority 1]
For example, allow the user to control font size through style sheets or the user interface. Or allow the user to magnify text.

Techniques:

- Implement the CSS ’font-size’ property.
- Allow the user to configure the user agent to ignore author-specified font family.
- Allow the user to set the default font family for the user agent.

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.

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.

4.5 Allow the user to control selection highlighting (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".

4.6 Allow the user to control focus highlighting (e.g., foreground and background color). [Priority 1]

Checkpoints for applets and animations:

4.7 Allow the user to control animation rate. [Priority 2]

Checkpoints for video.

4.8 Allow the user to control video frame rates. [Priority 1]
4.9 Allow the user to control the position of audio closed captions . [Priority 1]
4.10 Allow the user to start, stop, pause, and rewind video. [Priority 2]

Checkpoints for audio:

4.11 Allow the user to control audio playback rate. [Priority 1]
4.12 When the user agent renders audio natively, allow the user to control the audio volume. [Priority 2]
4.13 Allow the user to start, stop, pause, and rewind audio. [Priority 2]

Checkpoints for synthesized speech:

4.14 Allow the user to control synthesized speech playback rate. [Priority 1]
4.15 Allow the user to control synthesized speech volume. [Priority 1]
4.16 Allow the user to control synthesized speech pitch, gender, and other articulation characteristics. [Priority 2]

Checkpoints for the user interface:

4.17 Allow the user to select from available author, user, and user agent default style sheets. [Priority 1]

Note. Users should be able to select no style sheets (i.e., turn them off).

4.18 Allow the user to control user agent-initiated spawned viewports . [Priority 2]

For example, in HTML, 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 1.0, allow the user to control viewports created with show="new". Control may involve prompting the user to confirm or cancel the viewport creation. 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).

Techniques:

User agents may:

- Allow users to turn off support for spawned viewports entirely
- Prompt them before spawning a viewport

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

Guideline 5. Observe operating system conventions and standard interfaces

5.1 Provide accessible APIs to other technologies. [Priority 1]

5.2 Use accessibility resources and conventions of the operating system and supported programming languages, including those for plug-ins and virtual machine environments. [Priority 1]

For instance, 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.

Techniques:

The operating system application programming interfaces (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.

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 as well as other pieces of information discussed in this document.

Write output to and take input from standard system APIs rather than direct 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 Provide programmatic read and write access to user agent functionalities and user interface controls. [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. Refer also to checkpoint 5.2.

5.4 Implement selection and focus mechanisms and make the selection and focus available to users and through APIs. [Priority 1]

Refer also to checkpoint 7.1 and checkpoint 5.3.

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

Refer also to checkpoint 5.2.

5.6 Conform to W3C Document Object Model specifications and export interfaces defined by those specifications. [Priority 1]

For example, refer to [DOM1] and [DOM2] . User agents should export these interfaces using available operating system conventions. **Note.** 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."

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 content.
- 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 [DOM1] and [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 many 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.

Note. *The WAI Protocols and Formats Working Group is focusing its efforts on the DOM as the conduit from which to extract accessibility information from and to enhance the accessibility of a rendered document through a user agent. It is this are should concentrate on for providing access to user agent documents.*

5.7 Provide programmatic exchange of information in a timely manner. [Priority 2]
This is important for synchronous alternative renderings and simulation of events.

5.8 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 10.5.

Techniques:

Develop the UA User Interface (UI) with standard interface 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. If your custom interface cannot provide information or operation as defined above, then you may need to design your UA using any additional options provided by that platform.

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 understands to be defined as modifier keys, and therefore a custom UA control should not attempt to define a new modifier key.

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 open specifications and their accessibility features

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]) discusses accessibility features of W3C specifications.

Techniques:

- The accessibility features of Cascading Style Sheets (refer to [CSS1] and [CSS2]) are described in [CSS-ACCESS] .
- The accessibility features of SMIL 1.0 (refer to [SMIL]) are described in [SMIL-ACCESS] .
- The following is a list of accessibility features of [HTML40] :
  - The "alt" attribute defined for the IMG, AREA, INPUT, and APPLET elements.
  - The "longdesc" attribute defined for IMG elements ([HTML40] , section 13.2). This attribute may be used to attach additional descriptive information to images if the "alt" description is insufficient.
  - The CAPTION element ([HTML40] , section 11.2.2) for rich table captions.
  - The ACRONYM and ABBR elements ([HTML40] , section 9.2.1) for acronyms and abbreviations.
  - The "summary" attribute for TABLE ([HTML40] , section 11.2.1) for

table summary information.
  - Table elements (THEAD, TBODY, TFOOT, COLGROUP, and COL) that group table rows and columns into meaningful sections.
  - Attributes ("scope", "headers", and "axes") so that non-visual browsers may render a table in a linear fashion, based on the semantically significant labels.
  - The NOSCRIPT element ([HTML40] , sections 18.3.1 and 16.4.1) for accessible alternatives to scripts.
  - The NOFRAMES element ([HTML40] , sections 18.3.1 and 16.4.1) for accessible alternatives to frames.
  - Support the "lang" attribute ([HTML40] , section 8.1).
  - The "tabindex" attribute ([HTML40] , section 17.11.1) for assigning the order of keyboard navigation within a document.
  - The "accesskey" attribute ([HTML40] , 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 [HTML40] or [XML] . For style sheets, implement [CSS1] , [CSS2] , or XSL. For mathematics, implement [MATHML] . For synchronized multimedia, implement [SMIL] . For access to the structure of HTML or XML documents, implement [DOM1] . For an event model, implement [DOM2] . Refer also to checkpoint 5.6.

Guideline 7. Provide navigation mechanisms

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 displayed individually (e.g., by a text browser or speech synthesizer), provide a list of links to individual frames. Navigating into a viewport makes it the current viewport.

Techniques:

- Some operating systems provide a means to navigate among *all* windows, not just those created by the user agent. This suffices for viewports that are windows. However user agents may also allow the user to shift the focus from window to window 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 view, restore the point of regard in the viewport . [Priority 1]
For example, when users navigate "back" and "forth" among views, for each view they should find the viewport position where they left it.

7.3 Allow the user to navigate just among cells of a table (notably left and right within a row and up and down within a column). [Priority 1]

Note. Navigation techniques include keyboard navigation from cell to cell (e.g., using the arrow keys) and page up/down scrolling. Refer also to checkpoint 1.1 and checkpoint 5.3.

Techniques:

All users should be able to quickly determine 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. Providing table summary information, when first navigating to a table allows the nature of a table to be easily determined. 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 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 forth 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.

More 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

7.4 Allow the user to navigate all active elements . [Priority 1]
Navigation mechanisms may range from sequential (e.g., serial navigation by tabbing) to direct (e.g., by entering link text) to searching on active elements only (e.g., based on form control text, associated labels, or form control names).

7.5 Allow the user to navigate just among all active elements . [Priority 2]
Refer also to checkpoint 7.4.

Techniques:

Sequential navigation includes all active elements. User agents might provide other navigation mechanisms limited to a particular type of element. For example "Find the next table" or "Find the previous form". The following techniques suggest some types of navigation.

- Serial navigation. It is important that application developers maintain a logical keyboard navigation order. The navigation order is defined as the order of navigation among components and component elements via the keyboard. Generally users navigate by tabbing between components or groups and using the arrow keys within a component group or component's elements. The ability to tab between software components is a key feature in the implementation of keyboard accessibility. (Cross-reference to keyboard access.) Buttons of common functionality, such as a set of radio buttons used to set the location of a panel (top left, bottom left, and so on.), should be grouped together so the first element of the visible group can be tabbed to. Allow the user to use the arrow keys to navigate to each end of the group.
- How to indicate that something is in tabbing order in Java: A component is inclusive in the tabbing order when added to a panel and its isFocusTraversable() method returns true. A component can be removed from the tabbing order by simply extending the component, overloading this method, and returning false.
- For active elements, navigation to the previous or next active element.
- In a table, up/down and left/right.

Direct navigation: Excessive use of serial navigation can reduce the usability of software for both disabled and non-disabled users. As a developer, you need to determine the point at which tabbing gets in the way and provide a keyboard alternative. This is done through the use of keyboard shortcuts. Note that user agents must provide information about available shortcuts (the current keyboard configuration) to users.

- Need for element identification.
- Access by position in document.
- Next/Previous occurrence of text in an element's content (e.g., first letter) in the current document.
- In a table, access to cell based on coordinates.

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

Techniques:

- Allow users to search for element content and attribute values (human-readable ones).
- 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 alternative text.
- 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 search closest timestamp from a text stream or a media elements or links and find other media elements active at the same time.
    - 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).

7.7 Allow the user to navigate according to structure. [Priority 2]
For example, allow the user to navigate familiar elements of a document: paragraphs, tables, headers, lists, etc.

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 DTD navigation. E.g., properly nesting headers in HTML. Headers should be used only to convey hierarchy, not for graphical side-effects.
- 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.

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.

7.8 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 expand or shrink portions of the structured view (control detail level) for faster access to important parts content.

Guideline 8. Help orient the user

8.1 Provide a mechanism for highlighting and identifying (through a standard interface where available) the current viewport , selection , and focus . [Priority 1]
Note. This includes highlighting and identifying frames. Refer also to checkpoint 9.1..

Techniques:

- If colors are used to highlight the current viewport, selection, or 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.

Refer also to the section on frame techniques

8.2 Convey 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 caption and summary information, cell position information, table dimensions, etc. **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).

8.3 Provide an outline of a resource view built from its 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.

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

Note. [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:

- 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 focused link).

8.5 Provide information to help the user decide whether to follow a focused link. [Priority 2]

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

Techniques:

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

8.6 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 8.3. Refer also to checkpoint 5.3.

8.7 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 8.5.

Techniques:

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

8.8 Provide a mechanism for highlighting and identifying (through a standard interface where available) active elements. [Priority 3]

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

8.9 Maintain consistent user agent behavior and default configurations between software releases. Consistency is less important than accessibility and adoption of operating system conventions. [Priority 3]

In particular, make changes conservatively to the layout of user interface controls, behavior of existing functionalities, and default keyboard configuration.

Guideline 9. Notify the user of content and viewport changes

9.1 Provide information about user agent-initiated content and viewport changes directly to the user and through APIs. [Priority 1]

For example, inform the users when a script causes a popup menu to appear.

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 (does [DOM2] have this already?)

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

Techniques:

- There are time when the 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 focus must be 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 focus that is the found object under a search popup.
- Only change selection/focus in the current viewport.

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]

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 focussed, 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.

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

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

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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 resource 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.

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. Depending on how the user has been browsing, the percentage may be calculated according to focus position, selection position, or viewport position.

Techniques:

- Provide a scrollbar for 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 (mileposts)
- 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

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Guideline 10. Allow the user to configure the user agent

10.1 Provide information about the current user-specified input configuration (e.g., keyboard or voice bindings specified through the user agent’s user interface). [Priority 1]

Techniques:

If the current configuration changes locally (e.g., a search prompt opens that changes the keyboard mapping for the duration of the prompt), the user must be able to know about the current configuration. Users may have an easier time remembering named configurations - "this is the configuration in this particular mode."

Tabbing order:

- How to specify in HTML

Keyboard shortcuts

- How to specify in HTML
- Visibility of.
- Documentation of. At a minimum: list in README file that comes with software.

Some suggestions:

1. Allow the user to use the find command to jump to a link instead of tabbing there. It would save a lot of keystrokes, especially if one programs the keystrokes as macros. But this requires that focus moves to the location that find highlights.
2. Allow the user to use find command to jump to text in buttons.
3. Allow the user to use find command to jump to image by searching on its alternative content (e.g., "alt" attribute).
4. Allow the user to separate setting the focus and activating the control. For

links, first-time users of a page may want to hear link text (focus) before deciding whether to follow the link (activate). More experienced users of a page would prefer to follow the link directly, without the intervening focus step.

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

In case of conflicts between author-supplied configuration and user-supplied, operating system defaults, or user agent default configurations, here is some possible behavior:

- Do not over-ride default system and user agent controls, but alert the user of author-supplied configuration and provide a pass-through mechanism to allow author-specified configurations that conflict with default UA or OS keybindings to be invoked.
- Allow author-defined configurations to override user agent and operating system configurations, but alert the user of the conflicts and provide a pass-through mechanism so that the conflicting user agent or operating system configurations can be invoked.
- Remap author-supplied configurations to currently unused keystrokes, voice commands, etc. and alert the user to which configurations have been remapped.

10.2 Provide information about the current author-specified input configuration (e.g., keyboard bindings specified in content such as by "accesskey" in [HTML40]). [Priority 2]

Techniques:

Distinguish the following classes of user input bindings:

- bindings that are in effect and agree with the shipping defaults for the base browser
- bindings that are in effect but differ from the shipping defaults
- bindings that are in effect for this document only (subset of previous class)
- bindings no longer in effect because they have been overridden

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.

10.3 Allow the user to change and control the input configuration . Users should be able to activate a functionality with a single-stroke (e.g., single-key, single voice command, etc.). [Priority 2]

Users should not be required to activate functionalities by navigating through the graphical user interface (e.g., by moving a mouse to activate a button or by pressing the "down arrow" key repeatedly in order to reach the desired activation mechanism. Input configurations should allow quick and direct access that does not rely on graphical output. For self-voicing browsers, allow the user to modify what voice commands activate functionalities. Similarly, allow the user to modify the graphical user interface for quick access to commonly used functionalities (e.g., through buttons).

Techniques:

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 actions 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 [HTML40] , authors may specify keyboard behavior with the "tabindex" and "accesskey" attributes.

10.4 Use 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.

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 (refer to [JAVA-TUT]) and Microsoft Foundations Classes for Windows.

10.5 Avoid default input configurations that interfere with operating system conventions. [Priority 2]

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

10.6 Allow the user to configure the user agent in named profiles that may be shared (by other users or software). [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, etc.

The user should be able to easily transfer profiles between installations of the same user agent. 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.

10.7 Provide default input configurations for frequently performed operations. [Priority 3]

Make it easy to use the most frequently requested commands. In particular, provide convenient mappings to functionalities that promote accessibility such as navigation of links.

10.8 Allow the user to configure the graphical arrangement of 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 interface in a device-independent manner (e.g., through a text-based profile).

Guideline 11. Provide accessible product documentation and help

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 one must be accessible as per [WAI-WEBCONTENT] . Alternative content, navigation mechanisms, and illustrations will all help make the documentation accessible.

Techniques:

Documentation created in HTML should follow the [WAI-WEBCONTENT] .

Electronic documentation created in open standard formats such as HTML and ASCII can often be accessed in the user’s choice of application such as a word processor or browser. 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.

Users with print impairments may need or desire documentation in alternative formats such as Braille, 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.

11.2 Document all user agent features that promote accessibility. [Priority 1]

For example, review the documentation or help system to ensure that it discusses 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.

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

For example, documentation of what user agent features may be activated with a single keystoke, voice command, or button activation is an important part of the user interface to users visual impairments, some types of movement impairments, or multiple disabilities. Without this documentation,these users may not realize they can accomplish a particular task with a single gesture and so might unnecessarily avoid that feature of the software. Or they might waste time and energy using a very inefficient technique to perform a task.

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.

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

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	*	*	*
Scroll to bottom	*	*	*
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	?	?	?

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 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, document all features of the user agent that promote accessibility. [Priority 2]

---

3 Accessibility Topics

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

3.1 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 ’display’ and ’visibility’ properties of [CSS1] .

Implement CSS ([CSS1] , [CSS2]) including the CSS2 cascade order and user style sheets. The CSS2 cascade order ensures that user style sheets with "!important" take precedence over author style sheets, giving users final control. Style sheets give authors design flexibility while offering users final control over presentation (refer also to [WAI-WEBCONTENT] , checkpoint 3.3). 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 a 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 ([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 ([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 audio 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 video tracks (including captions, subtitles and signed translations) and to apply CSS stylesheets to text-based presentation and SVG.

For user agents rendering speech:

CSS2 ([CSS2]]) properties for speech 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) @@CMN: Opera does this.@@

- 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 (@@CMN: MS Word does this. This is also related to reconfiguring commands, etc.@@)

3.2 Link techniques

- Address broken link handling so that it doesn't disorient users. For example, leave 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.
  - 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 :before from [CSS2] to clearly indicate that something is a link (e.g., 'A:before { content : "LINK:" }').
- Implement the CSS pseudo-class ':hover'.

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 is focused.
- Get information about a focused link on demand, even if automatic rendering has been turned off.

3.3 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 impairments 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 impairments and learning disabilities may not be able to understand the purpose of a table or table cell.

3.3.1 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]).

3.3.2 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 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.

3.3.3 Cell header algorithm

User agents should use the algorithm to calculate header information provided in the HTML 4.0 specification ([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.

3.3.4 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 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.

3.4 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. 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 NOFRAMES in [HTML40]).
- 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 TITLE element in HTML) 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 in 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 content.
- 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.

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 impairments who are 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 no frames 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>
```

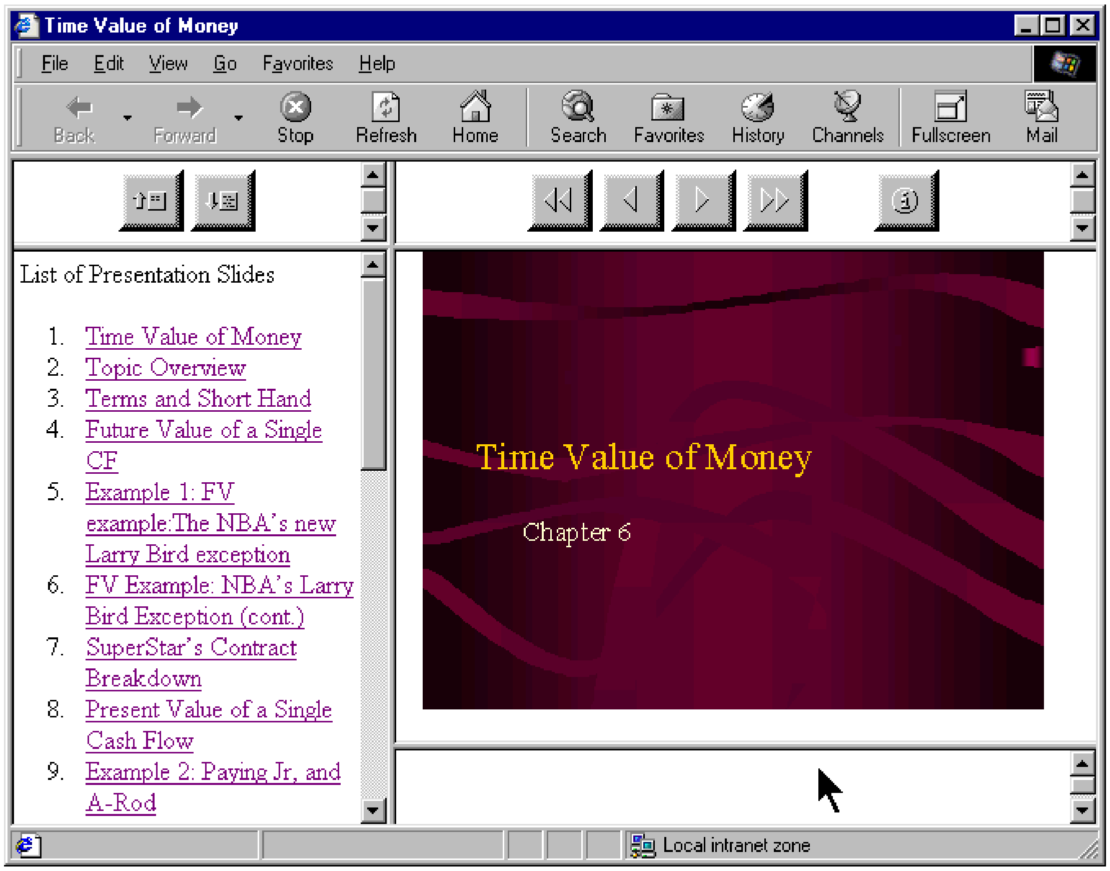
```
<FRAMESET COLS="*, 388">
  <FRAMESET ROWS="51, *">
    <FRAME src="sizebtn" marginheight="5" marginwidth="1"
       name="Size buttons" title="Size buttons">
    <FRAME src="outlinec" marginheight="4" marginwidth="4"
       name="Presentation Outline"
           title="Presentation Outline">
  </FRAMESET>

  <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:


Time Value of Money
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail
Time Value of Money
Chapter 6
Local intranet zone

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

Rendering by Lynx on Linux:

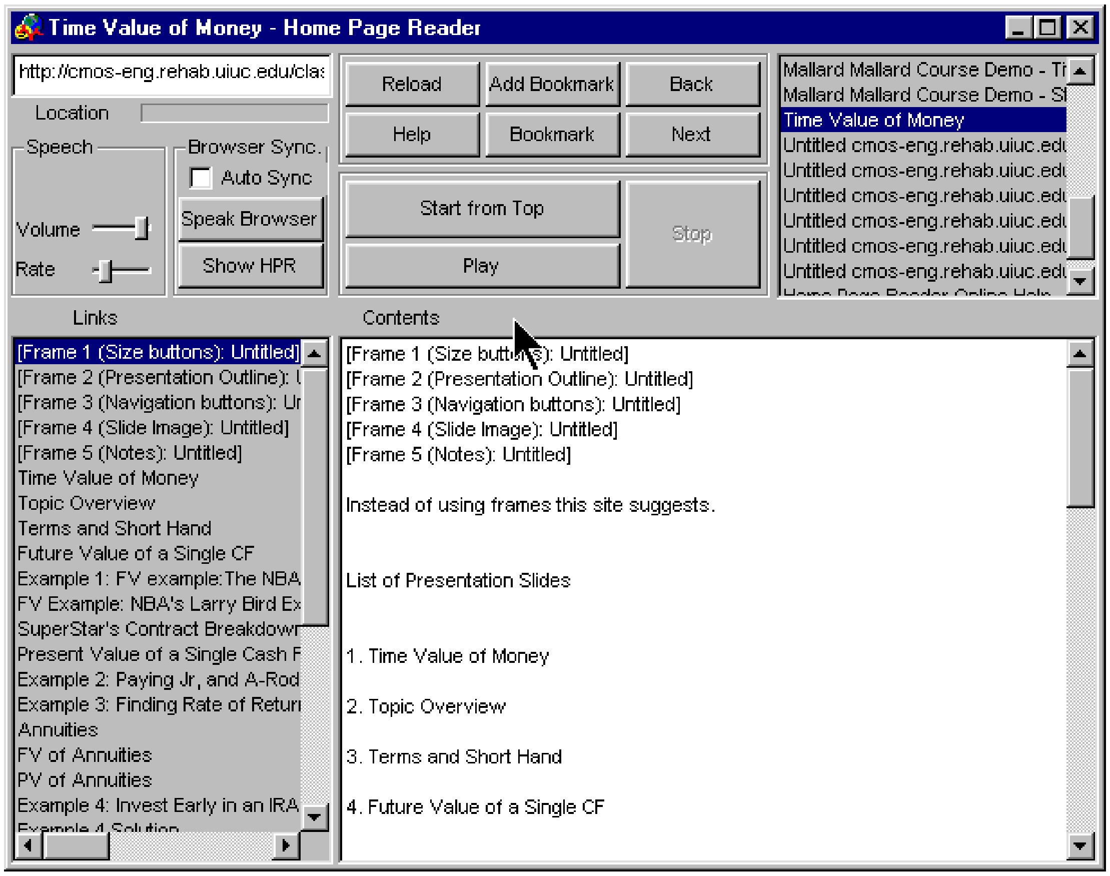
```
                              Time Value of Money

   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:



Mallard Mallard Course Demo - Ti
Mallard Mallard Course Demo - Sl
Time Value of Money
Untitled cmos-eng.rehab.uiuc.edu
Untitled cmos-eng.rehab.uiuc.edu
Untitled cmos-eng.rehab.uiuc.edu
Untitled cmos-eng.rehab.uiuc.edu
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Untitled cmos-eng.rehab.uiuc.edu

[Frame 1 (Size buttons): Untitled]
[Frame 2 (Presentation Outline): U
[Frame 3 (Navigation buttons): Ur
[Frame 4 (Slide Image): Untitled]
[Frame 5 (Notes): Untitled]
Time Value of Money
Topic Overview
Terms and Short Hand
Future Value of a Single CF
Example 1: FV example:The NBA
FV Example: NBA's Larry Bird Ex
SuperStar's Contract Breakdown
Present Value of a Single Cash F
Example 2: Paying Jr, and A-Rod
Example 3: Finding Rate of Retur
Annuities
FV of Annuities
PV of Annuities
Example 4: Invest Early in an IRA

[Frame 1 (Size buttons): Untitled]
[Frame 2 (Presentation Outline): Untitled]
[Frame 3 (Navigation buttons): Untitled]
[Frame 4 (Slide Image): Untitled]
[Frame 5 (Notes): Untitled]

Instead of using frames this site suggests.

List of Presentation Slides

1. Time Value of Money

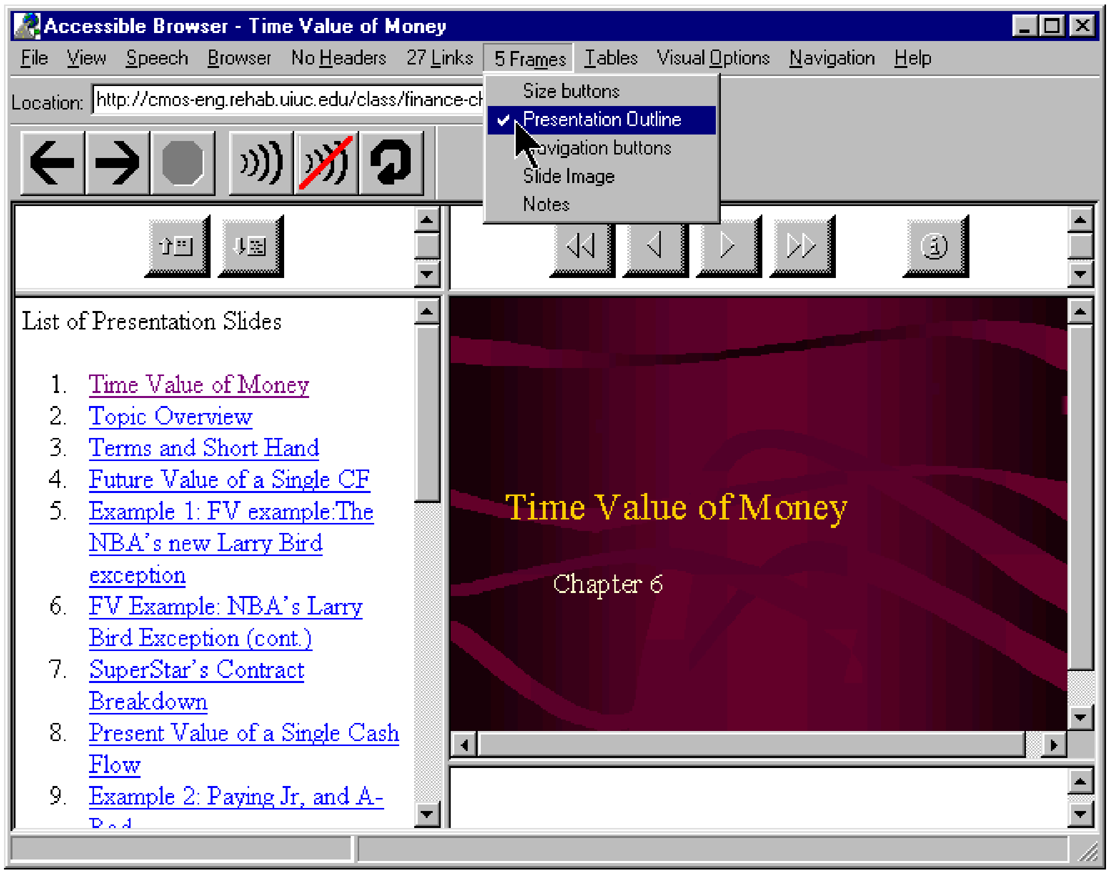
2. Topic Overview

3. Terms and Short Hand

4. Future Value of a Single CF

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:



Location: http://cmos-eng.rehab.uiuc.edu/class/finance-ch

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-

3.5 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.
- Provide information about what is required for each form control.
- Provide information about the order of form controls (e.g., as specified by "tabindex" in HTML). This is important since users that access forms serially need to know they have supplied all the necessary information before submitting the form.

Statement of form submission problems from Gregory Rosmaita:

Point A: As a user, I do *not* want to be prompted time I submit a form, provided that I submitted the form by activating its submit button. If, however, I simply hit the ENTER or the RETURN key from within a FORM control (i.e., rather than explicitly activating the SUBMIT mechanism), I would like the UA to request confirmation before submitting the form content.

Point B: As a user, I do NOT want the form content automatically submitted if I inadvertently press the ENTER or RETURN key.

PROBLEM STATEMENT FOR POINT B:

> Inadvertently pressing the RETURN or ENTER key is quite a prevalent phenomenon amongst 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 problems 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.

Moreover, I would like to stress that the "Auto-Submit-On- Enter" feature is not only quite problematic for one operating in an eyes-free environment, but for those unaccustomed to using online forms, and for those unfamiliar with a particular user agent's default key- bindings for forms, as well as those (like myself and countless others) who surf the Web using a variety of browsers, often switching from browser to browser -- ALT- TAB-ing from Lynx32 to MSIE to Opera, for example -- in order to better comprehend the contents of a page or while attempting to navigate an poorly structured site or a poorly marked-up form

Point C: As a speech user, I am constantly 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.

PROBLEM STATEMENT FOR POINT C:

> 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 Web surfer 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

Note. I have chosen to address the issue of pseudo-forms in this context, for, although they straddle the boundary between "Form Controls" and Checkpoint 5.8, pseudo-forms rely on FORM elements for activation This issue has been raised in the past, particularly by Chris Kreussling.

Techniques:

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"

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

3.6 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".

3.7 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 specified 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 specified 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 format.

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 [MS-KEYBOARD] .

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

- StickyKeys: modifier keys include SHIFT, CONTROL, and ALTERNATE. Keyboard Mappings: 5 consecutive clicks of Shift key turns on/off StickyKeys.
- FilterKeys: grouping term for SlowKeys, RepeatKeys, and BounceKeys. Shift key held down for 8 seconds turns on/off SlowKeys and RepeatKeys.
- MouseKeys: Left shift + left alt + numlock, turns on/off.
- ToggleKeys: Numlock key held for 5 seconds, turns on/off ToggleKeys
- SoundSentry:
- ShowSounds:
- Automatic reset: term used for TimeOut
- High Contrast: left shift + left alt + print screen, turns on/off High Contrast.
- SerialKeys:

Other keyboard shortcuts:

- 6 consecutive clicks of Control key turns on/off screen reader numeric keypad.
- 6 consecutive clicks of Alt key reserved for future use.

The Keyboard Response Group (KRG) contains three functions: RepeatKeys, SlowKeys, and BounceKeys. The KRG can be turned on from the keyboard with the pre-stored user default settings. There should also be an emergency activation scheme to turn the KRG on in some minimal configuration for those times or for those users who cannot operate the computer keyboard without a particular KRG function (e.g., SlowKeys). **Note.** SlowKeys and BounceKeys are mutually exclusive. In other words, if the acceptance delay for SlowKeys is some value other than "0", then the delay value for BounceKeys must be "0". SlowKeys and BounceKeys can both be "0", or in effect off, while RepeatKeys is on, or either SlowKeys or BounceKeys can be on with RepeatKeys. Therefore the following KRG combinations can be set by the user:

- RepeatKeys alone,
- SlowKeys alone,
- BounceKeys alone,
- SlowKeys and RepeatKeys,
- BounceKeys and RepeatKeys

The common modifier for activation of the KRG is to press and hold the right VK_SHIFT key for 8 seconds (note, emergency activation when the right VK_SHIFT key is held for 12 or 16 seconds.

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, 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). Some example tests include:

- All functional UI 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 functional UI components must track selection and 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 functional UI 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 functional UI 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 access 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 access 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 performed 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 performed 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 (refer to [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.

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. Refer also to checkpoint 5.3.
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 serial 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 7.4.
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 [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, authors can generate content with the ':before' and ':after' pseudo-elements. For more information, refer to [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.

7 Appendix: Terms and Definitions

Active element

Active elements constitute a user interface for the document. They 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 associated 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 focus to designate the active element the user wishes to trigger.

Applicable checkpoint

If a user agent offers a functionality, it must ensure that all users have access to that functionality or an equivalent alternative. Thus, if the user agent supports keyboard input, it must support accessible keyboard input. If the user agent supports images, it must ensure access to each image or an alternative equivalent supplied by the author. If a user agent supports style sheets, it must implement the accessibility features of the style sheet language. If the user agent supports frames, it must ensure access to frame alternatives supplied by the author.

Not all user agents support every content type, markup language feature, input or output device interface, etc. When a content type, feature, or device interface is not supported, checkpoints with requirements related to it do not apply to the user agent. Thus, if a user agent supports style sheets at all, all checkpoints related to style sheet accessibility apply. If a user agent does not support style sheets at all, the checkpoints do not apply.

The applicability of checkpoints related to markup language features is measured similarly. If a user agent supports tables, it must support the accessibility features of the language related to tables (or images, or frames, or video, or links, etc.). The Techniques Document includes information about the accessibility features of W3C languages such as HTML, CSS, and SMIL.

The following summarizes criteria for applicability. A checkpoint applies to a user agent unless:

- The checkpoint definition states explicitly that it only applies to a different class of user agent.
- The checkpoint includes requirements about a content type (script, image,

video, sound, applets, etc.) that the user agent does not recognize at all.

- The checkpoint includes requirements about a content type that the user agent recognizes but does not support natively .
- The checkpoint refers to the properties of an embedded object (e.g., video or animation rate) that may not be controlled or accessed by the user agent.
- The checkpoint includes requirements about an unsupported markup language or other technology (e.g., style sheets, mathematical markup language, synchronized multimedia, metadata description language, etc.)
- The checkpoint refers to an unsupported input or output device interface. Note that if the interface is supported at all, it must be supported accessibly.

Assistive Technology

Software or hardware that has been specifically designed to assist people with disabilities in carrying out daily activities. Assistive technology includes wheelchairs, reading machines, devices for grasping, alternative computer keyboards or pointing devices, etc. In the area of Web Accessibility, common software-based assistive technologies include assistive technologies, which rely on other user agents for input and/or output. These include:

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

Configure

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

Continuous Equivalent Track

A continuous equivalent track presents an equivalent alternative to another track (generally audio or video) and is synchronized with that track. Continuous equivalent tracks convey information about spoken words and non-spoken sounds such as sound effects. A continuous text track presents ***closed captions***. Captions are generally rendered visually by being superimposed over a video track, which benefits people who are deaf and hard-of-hearing, and anyone who cannot hear the audio (e.g., when in a crowded room). A ***collated text transcript*** combines (collates) captions with text descriptions of video information (descriptions of the actions, body language, graphics, and scene changes of the video track). These text equivalents make presentations accessible to people who are deaf-blind and to people who cannot play movies, animations, etc.

One example of a non-text continuous equivalent track is an ***auditory description*** of the key visual elements of a presentation. The description is either a prerecorded human voice or a synthesized voice (recorded or generated on the fly). The auditory description is synchronized with the audio track of the presentation, usually during natural pauses in the audio track. Auditory descriptions include information about actions, body language, graphics, and scene changes.

A video track that shows sign language is another example of a continuous equivalent track.

Control

User control of the user agent - interface, behavior, styles, etc. - 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 available colors, within the limits offered by the operating system or user agent.

The term "control" also means "user interface component" or "form component" in this document. Which meaning is intended should 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***. Elements are defined by a language specification (e.g., HTML 4.0 or an XML application). Each element may have content, which generally contributes to the document's content. Elements may also have ***attributes*** that take values. An element's ***rendered content*** is that which a user agent renders for the element. This may be what lies 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). Rendering is not limited to graphical displays alone, but also includes audio (speech and sound) and tactile displays (braille and haptic displays).

Since rendered content is not always accessible, authors must specify ***alternative equivalents for content*** that user agents must make available to users or software that require it (in place of and/or in addition to the "primary" content). Alternative representations may take a variety of forms including alternative text, closed captions, and auditory descriptions . The Techniques Document ([UA-TECHNIQUES]) describes the different mechanisms authors use to supply alternative representations of content. Please also consult the Web Content Accessibility Guidelines ([WAI-WEBCONTENT] and ([WAI-WEBCONTENT-TECHS] .

Events and scripting

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] and scripting is commonly referred to as "Dynamic HTML" or DHTML. However, as there is no W3C specification that formally defines DHTML, this document will only refer to event handlers and scripts.

Focus

The user focus designates an active element in a document. A viewport has at most one focus. When several viewports co-exist, each may have a focus, but only one is active, called the ***current focus***. The current focus is generally presented (e.g., highlighted) in a way that makes it stand out.

Highlight

Any mechanism used to emphasize selected or focused content. Visual highlight mechanisms include dotted boxes, underlining, and reverse video. Synthesized speech highlight mechanisms may include altering voice pitch or volume.

Input Configuration

Every user agent functionality available to the user is mapped to some user interface mechanism, including menus, buttons, keyboard shortcuts, voice commands. The default input configuration is the mapping the user finds after installation of the software. The documentation should tell users what functionalities are available and the user interface should remind users of the current mapping to the user interface and allow them to figure out quickly how to use the appropriate software features.

Insertion point

The insertion point is the location where document editing takes place. The insertion point may be set by the user (e.g., by a pointing device or the keyboard editing keys) or through an application programming interface (API). A viewport has at most one insertion point. When several viewports co-exist, each may have an insertion point, but only one is active, called the ***current insertion point***

The insertion point is generally rendered specially (e.g., on the screen, by a vertical bar or similar cursor).

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. Native support does not preclude more extensive support for accessibility by assistive technologies , so user agents must still make information available through APIs.

Natural Language

Spoken, written, or signed human languages such as French, Japanese, American Sign Language, and braille. The natural language of content may be indicated in markup (e.g., by the "lang" attribute in HTML ([HTML40] , section 8.1) or by HTTP headers.

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, paper, through speakers, a braille device, 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 has the meaning ascribed in the CSS2 Recommendation [CSS2] .) 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 started up is called the property's ***default value***. User agents may allow users to change default values through a variety of mechanisms (e.g., the user interface, style sheets, initialization files, etc.).

Once the user agent is running, the value of a property for a given document or part of a document may be changed from the default value. The value of the property at a given moment is called its ***current value***. Note that changes in the current value of a property do not change its default value.

Current values may come from documents, style sheets, scripts, or the user interface. Values that come from documents, their associated style sheets, or via a server are called ***author styles***. Values that come from user interface settings, user style sheets, or other user interactions are called ***user styles***.

Recognize

A user agent is said to recognize markup, content types, or rendering effects when it can identify (through built-in mechanisms, 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]) discusses some content that affects accessibility and should be recognized as such.

Selection

The user selection generally specifies 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 user 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 user selection. When several viewports co-exist, each may have a user selection, but only one is active, called the ***current user selection***.

The user selection is usually presented in a way the stands out (e.g., highlighted). On the screen, the selection may be highlighted using colors, fonts, graphics, or other mechanisms. Highlighted text is often used by assistive technologies to indicate through speech or braille output what the user wants to read. Most screen readers are sensitive to highlight colors. 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 that includes spoken words and non-spoken sounds such as sound effects. Refer also to continuous equivalent track .

Spawned Viewport

Viewports that are created by the user agent process. This refers to viewports that display content and does not include, for example, messages or prompts to the user.

Standard Device APIs

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 that should be used by user agents and other software for input and output to those devices. For example, for desktop computers today, user agents are expected to use the mouse and keyboard APIs for input. 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. **Note.** What is considered "standard" for a particular environment will change over time.

User-initiated and 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 resources, including text, graphics, sounds, video, images, and other objects. An user agent may require additional software to handle some types of content. For instance, a browser may run a separate program or plug-in to render sound or video. The additional software is also considered a user agent. 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.

Views, Viewports, and Point of Regard

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, frame, a piece of paper, a panner, a speaker, a virtual magnifying glass, etc. A viewport may contain another viewport (e.g., nested frames, plug-ins, etc.).

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 is *how* source information is rendered and the viewport is *where* it is rendered. Both the current focus and the current user selection must be in the

same viewport, 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.
The content currently available in the viewport is called the user's ***point of regard***. The point of regard may be 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.

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9 References

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

[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.

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[DOM1]
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"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.

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[HTML32]
"HTML 3.2 Recommendation", D. Raggett, ed. The HTML 3.2 Recommendation is http://www.w3.org/TR/REC-html32

[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.

[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/TR/1999/WD-WAI-USERAGENT-19991105/full-checklist) or list form (at http://www.w3.org/TR/1999/WD-WAI-USERAGENT-19991105/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/TR/1999/WD-WAI-USERAGENT-TECHS-19991105. The latest draft of the techniques is available at http://www.w3.org/TR/WAI-USERAGENT-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

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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.

[BHO]
Browser Helper Objects: The Browser the Way You Want It, D. Esposito, January 1999.

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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/.

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"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.

[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).

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

[PRODWORKS]
The Productivity Works.

[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.

[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.