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# Web Access: How accessibility needs shaped web development

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## Introduction

The internet has over the past few decades become an essential part of daily life, providing access to information, services and communications for billions of users worldwide(Statista 2024). However, during the first years, it was mostly inaccessible to those with disabilities. With the internet becoming such an important source of information and part of everyday life, accessibility has emerged as a fundamental aspect of web design and development, ensuring that individuals with visual, physical, cognitive and auditory impairments can effectively access and interact with its digital content.

Web accessibility is guided by a series of practices and principles aimed at creating equal online experiences. The World Wide Web Consortium (W3C) released the first version of the Web Content Accessibility Guidelines (WCAG) only a few years after the first website was created. Since then, W3C has maintained accessibility as a key priority, continuously updating the guidelines to adapt to evolving web technologies.

The implementation of the standards that WCAG put in place has exponentially reshaped the field of web development, encouraging inclusivity and innovation. Features like screen readers, keyboard focused navigation and closed captions not only improve accessibility, but also enhance the overall user experience, benefiting users in all kinds of situations, from loss of hearing to mobility issues and visual impairments.
The shift towards a more accessible web reflects a broader societal recognition of the rights and needs of people with disabilities, pushing web developers to adopt standards and techniques that accommodate diverse user experiences.

This paper explores how the imperative of accessibility has influenced the trajectory of web development. By examining key milestones and developments – from the early days of web design to the integration of accessibility guidelines and modern inclusive practices – this paper

highlights how the demand of accessible web experiences has reshaped the field and how these changes continue to create a more inclusive web for everyone.

# 1. History and Categorization

## 1.1 Background

The evolution of the internet has been nothing but a journey from simplicity to immense complexity, shaped by the growing demands of a ever growing user base. From the first website was published by Tim Berners-Lee back in August 1991 (Fischels 2021) and all the way to today, the world wide web has been in a constant and rapid state of evolution and development. What was in the beginning just simple text pages coded HTML [1]and CSS [2]documents in a text editor is now a myriad of HTML, PHP, CSS and JavaScript [3] files spread across different servers and are include images, videos, audio and a constantly increasing number of interactive elements.

After Berners-Lee invented the internet back in 1989, and the first web site in 1991, the internet started increasing in popularity and usage, and quickly became more and more mainstream. More and more websites were developed and released, and companies started to invest more and more finances and resources into the web. People also started turning more to the internet for information and other essential services, such as communication. This increasing dependence exposed a growing exclusion faced by users with disabilities, many of whom could not navigate web pages the same way as others without their needs being met by the developer. Advocacy groups and organizations began to call for a more inclusive, digital space, recognizing that equal access to the web was a fundamental right.

In response to these challenges, Tim Berners-Lee formed the Web Consortium and started its essential work in fostering a consistent architecture for the web that would accommodate the rapid pace in development of web standards for building both web browsers and websites. After

[1] HyperText Markup Language
[2] Cascading Style Sheets
[3] A selection of programming languages used to develop websites. HTML /CSS for frontend visual elements and PHP and JavaScript for more functional scripting.

several discussions and meetings throughout 1994, the World Wide Web Consortium (W3C) was created as an organization within MIT in October of 1994. (W3 Consortium 2024) In 1997, W3C formed the Web Accessibility Initiative, and only two years later, in 1999, the Web Content Accessibility Guidelines version 1.0 (WCAG 1.0) was released.

## 1.2 Categorizing Accessibility

Before digging into how accessibility needs formed web development, it's important to understand the categories of disabilities that developers aim to accommodate. Most disabilities fall into one of four main groups:

- **Visual Disabilities:** Includes blindness, low vision and color blindness. These all impact how a user perceive visual elements on a website to varying degrees.
- **Hearing Disabilities:** Includes deafness and hard-of-hearing.
- **Cognitive and Learning disabilities:** Includes conditions such as dyslexia, ADHD and memory disorders. These can affect how users process information or how they navigate more complex layouts.
- **Mobility Disabilities:** Includes users with limited motor control, paralysis or other conditions that make it difficult to interact with traditional input devices like a mouse or keyboard.

These categories help guide the design of accessibility features and ensure that digital spaces are usable for a wide range of users

Each category presents unique challenges and has led to the development of specific accessibility features for each category. In section 3 and 4 we will dive closer into what recommendations and guidelines have been implemented in websites to allow for accessible browsing and show some examples of these.

## 2. Where we started

The first website, published by Tim Berners-Lee in 1991, was a simple, text-based document with minimal formatting. Built using only HTML, it served as an information-sharing platform without any of the visual or interactive features common today. This simplicity defined the early web, non-static and focused solely on delivering basic content.

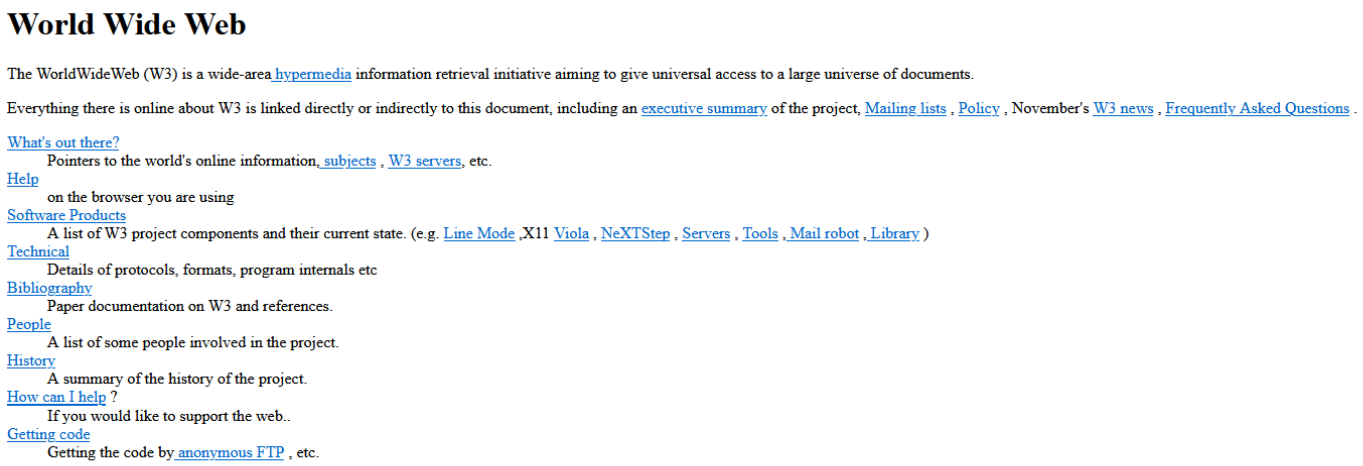
As the internet gained popularity, websites began to evolve rapidly. By the mid-1990s, developers introduced elements like images, videos and some basic interactivity through JavaScript. However, accessibility was not a consideration during this time. Websites were often designed for users with standard vision, hearing and mobility, leaving many disabled individuals unable to navigate or interact with the site's digital content effectively. For instance:

- Blind users lacked tools to interpret visual content
- Deaf users had no access to captions for multimedia
- Users with mobility impairments faced barriers due to mouse-dependent navigation.

The change towards accessibility began in the mid-to-late 1990s (W3 Consortium 2024), when the internet became a more integral part of everyday life. At this time, people increasingly started relying on websites for information, communication and services. This growing dependence highlighted the exclusion faced by users with disabilities, as they were unable to access vital content. Advocacy groups and a broader societal shift toward inclusivity prompted calls for a more accessible web.

In response, the W3C (World Wide Web Consortium) introduced the first set of rules for web accessibility, the *Web Content Accessibility Guidelines 1.0* (WCAG 1.0) in 1999. WCAG 1.0 aimed to establish a foundation for accessible design, offering checkpoints for web developers to follow and categorizing them by priority levels. This marked the first organized effort to standardize accessibility features.

Berners-Lee's website is still available today, having been preserved in it's original state on CERN's servers since it was first published.



**World Wide Web**

The WorldWideWeb (W3) is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an executive summary of the project, Mailing lists , Policy , November's W3 news , Frequently Asked Questions .

What's out there?
Pointers to the world's online information, subjects , W3 servers, etc.
Help
on the browser you are using
Software Products
A list of W3 project components and their current state. (e.g. Line Mode ,X11 Viola , NeXTStep , Servers , Tools , Mail robot , Library )
Technical
Details of protocols, formats, program internals etc
Bibliography
Paper documentation on W3 and references.
People
A list of some people involved in the project.
History
A summary of the history of the project.
How can I help ?
If you would like to support the web..
Getting code
Getting the code by anonymous FTP , etc.

*(Berners-Lee 1991)*

Today's web is built upon the foundation laid by the early efforts of the W3C and WCAG 1.0. While modern websites are vastly more complex, with dynamic interfaces and multimedia content, they also incorporate accessibility as a core principle. This evolution underscores the journey from exclusion to inclusion, driven by technological advancements and a broader societal commitment to equality.

## 3. Standards and regulations

The growing demand for accessible digital spaces led the W3C to launch the Web Accessibility Initiative (WAI) in 1997. This initiative aimed to develop a set of accessibility guidelines web developers should follow to make their website as accessible as possible. Two years after this initiative was formed, this work was finalized, and the first edition of the Web Content Accessibility Guidelines (WCAG) was released in 1999.

This first set of guidelines was divided into three priority levels:

- Priority 1 – A web content developer **must** satisfy this checkpoint (Level A)
- Priority 2 – A web content developer **should** satisfy this checkpoint (Level Double-A)
- Priority 3 – A web content developer **may** address this checkpoint (Level Triple-A)

The priority system was a way for developers to understand what features they should prioritize when developing websites and provided developers with techniques to help meet the checkpoint. An example of a Guideline and checkpoint would be:

> *"**Guideline 1: Provide equivalent alternatives to auditory and visual content**.*
> *Provide content that, when presented to the user, conveys essentially the same function or purpose as auditory or visual content. […]*
>
> ***Checkpoints:***
> ***1.1** Provide a text equivalent for every non-text element […] [Priority 1]" (W3 Consortium 1999)*

Through these guidelines and checkpoints, a website could obtain a conformance level based on how many priority levels were satisfied. If a website only satisfied the checkpoints marked priority 1, it would receive conformance level "A". If the site satisfied both priority 1 and priority 2 checkpoints, it would receive conformance level "Double-A" and lastly, if it satisfied all 3 priority checkpoints, it would receive conformance level "Triple-A". The W3C provided developers with two ways to show that the website had obtained a conformance level. Either a written statement could be put on the page as a footer, or an image could be inserted to the footer of the page which would show the conformance level.

1) Example of written statement:
   *"This page conforms to W3C's "Web Content Accessibility Guidelines 1.0", available at http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505, level Double-A." (W3 Consortium 1999)*

2) Example of image:

(W3 Consortium 1999)

WCAG 1.0 was superseded by WCAG 2.0 in 2008, but the main principles of the guidelines remained similar. The largest change to WCAG 2.0 from 1.0 was a reduction in total amount of guidelines (Down to 12 from 14), and all guidelines were now categorized under 4 principles often known under the term "P.O.U.R.", from the four words selected

- Perceivable
  - Information and user interface components must be presentable to users in ways they can perceive
- Operable
  - User interface components and navigation must be operable
- Understandable
  - Information and the operation of user interface must be understandable
- Robust
  - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies

(W3 Consortium 2008)

WCAG 2.0 also did away with the priority numbers on each checkpoint. Checkpoints were now marked with the conformance level the website would obtain when the site satisfied the requirements for that specific level. The requirements for reaching each level remained the same and the naming scheme was replaced.

| Priority | Conformance level |
|---|---|
| Priority 1 | Level A |
| Priority 2 | Level AA (Previously Double-A) |
| Priority 3 | Level AAA (Previously Triple-A) |

From a guideline perspective, the conformance levels went from must/should/may satisfy, to Basic, Mid-Range and High-Level accessibility, with Level A being Basic, only covering the essentials, Level AA covering the most common barriers and Level AAA covering a wide range of needs. When WCAG 2.0 was released in 2008, web development had evolved massively from

only HTML into using several different types of technologies, such as CSS for styling, JavaScript for more functionality and even support for Macromedia Flash (Later Adobe Flash) and other multimedia-focused functionalities. Because of this massive shift in included technologies, allowing more advanced content to be put on the website, WCAG 2.0 had to expand the rules from going strictly from what HTML could allow to understanding all the new possibilities. As an example, In WCAG 1.0 in Guideline 1.1, the following is noted;

> "Provide a text equivalent for every non-text element (e.g., via "alt", "longdesc", or in element content). This includes: images, graphical representations of text (including symbols), image map regions, animations (e.g., animated GIFs) […]"(W3 Consortium 1999)

In WCAG 2.0, this same section was reformulated to

> "Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language."(W3 Consortium 2008)

Where WCAG 1.0 primarily focuses on images and equivalent features, WCAG 2.0 now strictly points out that there should be provided a text alternative for any non-text content that is presented to the user in general.

Through the WCAG guidelines as first laid out in WCAG 1.0 and evolved through WCAG 2.2 which is the latest version as of writing, developers have created several accessibility features that now are used in most – if not all – websites. Some of these are outlined in the table below.

| Disability Type | Accessibility Features | WCAG 2.2 Rules |
|---|---|---|
| Visual Disabilities | Text alternatives, Screen reader compatibility, Keyboard navigation, High Contrast modes | - **Text alternatives (WCAG 1.1.1):** Requires alt text for non-text content<br>- **Contrast Ratio (WCAG 1.4.3):** Minimum Contrast levels between page elements<br>- **Keyboard Access (WCAG 2.1.1):** Ensures all actions and navigation can be performed using only a keyboard |
| Hearing Disabilities | Subtitles, Transcripts for Audio content, Visual indicators for sounds | - **Captions and Transcripts (WCAG 1.2.2/1.2.4):** Requires captions for audio and video content<br>- **Sign Language (WCAG 1.2.6):** Provides sign language interpretation for key content |
| Cognitive and Learning Disabilities | Consistent layouts, simplified text, visual cues, clearly defined interactions | - **Readable Text (WCAG 3.1.1/3.1.5):** Use of |

| | | |
|---|---|---|
| | | clear and readable language<br>- **Consistent Navigation (WCAG 3.2.3):** Requires uniform navigation across pages |
| Mobility Disabilities | Keyboard navigation, larger clickable areas, customizable input options, voice recognition support | - **Keyboard Accessibility (WCAG 2.1.1):** Ensures all actions and navigation can be performed using only a keyboard<br>- **Pointer Target Size (WCAG 2.5.5):** Specifies minimum size for interactive elements<br>- **Gesture Alternatives (WCAG 2.5.1):** Provides alternatives for complex gestures, such as drag-and-drop |

WCAG has become the cornerstone of accessibility standards worldwide, influencing regulations such as the Americans with Disabilities Act (ADA) (18F 2023), the European Union's Web Accessibility Directive (EU 2016) and even the Norwegian law "Forskrift om universell utforming av Informasjons- og kommunikasjonsteknologiske (IKT)-løsninger" (Forskrift om universell utforming av IKT-løsninger 2013)

## 4. The end result

After WCAG was introduced, web developers have created several features that allow users with disabilities all around the world to use web sites without any issues. We'll have a look at a couple pages and have a look at some of the accessibility features they have implemented.

### 1.4.1 YouTube

YouTube, one of the largest multimedia platforms globally, serves as a prime example of accessibility in action. Its features cater to users with a variety of disabilities, including:

- **Skip Navigation:** A hidden button. This button is not visible unless a user has pressed the tab-key on their keyboard to select it and allows to skip all the unnecessary top-bar content and skips right to the first available video on the page.
- **Closed Captioning:** All videos have automatically generated subtitles, with an viewers and creators being able to add their own captions, making videos viewable for those with reduced hearing or complete loss of hearing.
- **Playback Controls:** YouTube has also included a lot of accessibility features in their video player, with the biggest one being full control using just the keyboard. YouTube has set specific key-binds for every feature in their player, including;
    - Space and K: Play / Pause
    - J and L: Backwards / Forwards 10 seconds
    - Left / Right arrow: Backwards / Forwards 5 seconds
    - Up / Down arrow: Volume up / down
    - F: Enter or Exit Full Screen
    - C: Subtitles / Captions on / off

### 1.4.2 Microsoft Office Online

Microsoft Office Online exemplifies accessibility in productivity tools, ensuring that users with disabilities can effectively create and collaborate with each other. Of their many accessibility features, some key features include:

- **High-Contrast Mode:** Users can switch to a high-contrast display that makes text more readable for those with visual impairments or color blindness.
- **Keyboard Navigation:** All core functions, such as editing documents and navigating menus, are fully operable with a keyboard, accommodating users with mobility disabilities
- **Screen Reader Compatibility:** Office Online also works great with screen readers, making it easier for users with visual impairments to hear what's being written in the document and write and collaborate without having to see the screen.

### 1.4.3 Apple

Apple's website reflects the company's broader commitment to accessibility, with accessibility features thoughtfully being implemented on their website

- **Simplified Navigation:** Apple's clean layout and consistent design make it easy for users with cognitive disabilities to browse the page with little to no confusion.
- **Keyboard-Friendly Design:** Apple have made sure that all interactive elements, such as dropdown menus and forms, are fully accessible via keyboard controls.

## 5. Conclusion

The evolution of web accessibility reflects an ongoing commitment to inclusivity, equity and user-centered design. From the early, text-only pages of the 1990s to the complex and dynamic websites we look at on a daily basis today, the development of accessibility standards has played a crucial role in transforming the web into a universally accessible platform for all users, regardless of their abilities.

Today, standards like WCAG 2.2 demonstrate the impact of decades of advocacy and innovation, providing guidelines that address diverse needs and encompass a wide range of disabilities. As a result, millions of users who were once struggling to navigate the web can now engage meaningfully with its content. Features such as keyboard-only navigation, clear structure and alternative text enable users to experience the web on their terms, whether they are navigating through assistive technology or simply personalizing their viewing preferences.

Despite the achievements of the WAI and WCAG guidelines, the journey toward a fully inclusive web is far from over. Emerging technologies, such as Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) introduce new accessibility challenges that must be addressed. For example, AR and VR interfaces require innovative approaches to ensure usability for mobility-restricted users, and AI-Powered tools must be developed with inclusivity at their core, avoiding biases that could disadvantage users with disabilities.

Moving forwards, web developers must continue to prioritize accessibility and inclusivity, ensuring that digital spaces evolve alongside new technologies and user needs. By embracing accessibility as a fundamental principle, the web can remain a universal resource, allowing connections and opportunities for everyone.

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