Content accessibility of Web documents: Overview of concepts and needed standards

Alapetite, A.

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Content accessibility of Web documents: Overview of concepts and needed standards

Alexandre Alapetite

Risø National Laboratory
Roskilde
Denmark
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Author: Alexandre Alapetite
Title: Content accessibility of Web documents: Overview of concepts and needed standards
Department: Systems Analysis Department. Research Programme Safety, Reliability and Human Factors

Abstract:
The concept of Web accessibility refers to a combined set of measures, namely, how easily and how efficiently different types of users may make use of a given service. While some recommendations for accessibility are focusing on people with various specific disabilities, this document seeks to broaden the scope to any type of user and any type of use case. The document provides an introduction to some required concepts and technical standards for designing accessible Web sites. A brief review of the legal requirements in a few countries for Web accessibility complements the recommendations. Finally, the document describes some limitations of current Web accessibility guidelines and outlines some future challenges for research in this area.

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Risø National Laboratory
Information Service Department
P.O.Box 49
DK-4000 Roskilde
Denmark
Telephone +45 46774004
bibl@risoe.dk
Fax +45 46774013
www.risoe.dk

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1. Definitions

The concept of Web accessibility refers to a combined set of measures, namely, how easily and how efficiently different types of users may make use of a given service. While some recommendations for accessibility are focusing on people with various specific disabilities, this document seeks to broaden the scope to any type of user and any type of use case. The proposed definition of Web accessibility therefore also covers what is known as "universal design" and it comprises the standard principles for usability.

By 'different types of users', we refer to, for example, novices, experts, seniors, impaired people, non-native speakers, and even software robots. The different types of interface will include desktop computer screens, video projectors, printers, mobile electronic devices etc. Different types of use cases will include urgent professional use, casual and leisure use, entertainment etc. Finally, use situations may range from uses in the dark, under water, or while running to get the bus.

2. Introduction

Web sites are a domain where accessibility has been studied in detail by various actors, and where rules and recommendations have been established most precisely. That is why it is a good starting point when studying Web accessibility more generally. Section 5 about the content accessibility guidelines forms the core of this document, while sections 2 to 4 provide a background to this.

The year 1994 marks the beginning of real efforts for standardisations of the Web with the creation of the W3C (World Wide Web Consortium) [20]. In the following year, this group released the first standard recommendation for HTML, the language to build Web pages [1]. Since then, standardisation efforts have continued and have been highly influenced by the evolution of practices (increasing number of and types of users, new communication habits, etc.), hardware (new types of screens, computers, input systems, mobile devices, networks, etc.) and software (Web browsers, multimedia, etc.).

Only when the first technical standards were in place and began to spread did the concept of "accessibility" start to develop. The first step in this direction was the result of a W3C publication in December 1996 (CSS – Cascading Style Sheets) aimed at separating text content from layout structure [3]. The real recognition of accessibility needs came in February 1997, when the W3C launched the WAI group (Web Accessibility Initiative) [40], who then published its first recommendations in 1999 [30] and who is partly funded by the European Commission's Information Society Technologies Programme [45].

3. Web accessibility factors

The Web accessibility concept addresses several issues about specific needs of users, electronic devices, and software robots.

3.1. Users

Web accessibility is mainly aimed to ensure that people with various disabilities will be able to access the information, ranging from the simple need of a larger font to more severe disabilities such as blindness or motor limitations. Making content easier to browse and comprehend is also of a great help for people with cognitive limitations, for poor readers, for people who are not fluent in the target language, and even for users under stressful or time critical circumstances. For any user and any use situation, an accessible Web site is faster to use and to comprehend and therefore provides a greater chance of successful use. Finally, since users have different wishes and skills, it is advantageous to users that they be offered a possibility of customising the interface and tools such as search facilities.

3.2. Devices

Browsing devices have different capabilities, e.g., bandwidth, processing power, support of different human-computer input and output strategies. This is an important point to keep in mind as new mobile devices are becoming increasingly popular and diverse.
Furthermore, not all client devices have the same goal.

- Most of them try to render on screen exactly what the Web master expects, and even that is not always perfect, as shown by the Acid2 browser test [65]. One should be aware that some rendering problems are due to deficiencies, not of the target Web document, but of the browser.. In this perspective, browsers that have the highest degree of standard compliance should be preferred. It should be noted that in order to benefit from, or to evaluate, an accessible Web document, the accessibility of the browsing device itself must be taken into account. This can be checked against the W3C's user agent accessibility guidelines [32].
- Another category of devices includes those that try to modify Web documents in order to adapt them to specific users or situations. For instance, when a document designed for a large screen has to fit into a small PDA screen. It is also the case for people who want a Web page to be read aloud, or who use a text-based browser and Braille transcription.

All those devices work much better when documents are standard compliant and follow basic accessibility rules. Having common open standards is therefore crucial to successful implementation of accessibility.

3.3. Software

Finally, accessibility guidelines are also beneficial to software and robots. Software and hardware equipments are evolving rapidly, and following accessibility guidelines improves data. Furthermore, not only humans access Web documents, but also software tools such as search engines do so. For those software robots as well as for devices transforming the contents before displaying it to the user accessibility guidelines are important, because it is easier to automatically extract the semantics, such as title and subtitles, navigation paths, topics, etc.

Interestingly enough, many Web masters have started to integrate accessibility guidelines to improve their site ranking and the quality of indexation of the search engines. In the end, the same guidelines serve to solve different problems and cater to different needs.

4. Pre-required recommendations

When designing or evaluating a new Web site there is an order that is best to follow. First, one should consider the architecture of the Web site, then validate each part of its structure against the current standards in force, finally use the accessibilities guidelines (*cf.* section 5) by order of priority.

4.1. Architecture principles

4.1.1. Separation text-layout: one of the W3C's first achievements was to propose a good solution to separate text content from the layout structure. This is important because managing the content and the layout involves different technologies, which can be better validated when separated. It also offers the possibility to have various layouts, for the same content, targeted at different devices or situations, or simply to change the design of a Web site rapidly. Furthermore, a separated description of the layout can be reused on many pages, saving bandwidth and ensuring some layout consistency. Last but not the least, this separation principle is normally associated with a better semantic, good for accessibility and vital for some software (*cf.* subsection 3.3). The main standard allowing this separation of content and layout is CSS (Cascading Style Sheets) [3] (*cf.* paragraph 4.2.3).

4.1.2. International character set: Worldwide, there are many alphabets and other signs. Computers can only deal with numbers, and this implies an encoding convention; that is to say, a conversion table between characters and numbers. Many different incompatible character sets have been developed: in the European Union alone, twenty official languages (2005) are using five major encodings, in the ISO-8859-X family [27]. Fortunately, since 1991, the Unicode [6] standard is the recommended unification solution; it can deal with most of the needed characters in the World (already more than 96000 in version 4) and is widely supported.

4.1.3. Persistent Web addresses: Web addresses should be made in a scalable way so that it will not be needed to rename them when the Web site evolves [34]. If original addresses are badly chosen and need to be modified or removed, that should be done with proper HTTP mechanisms [8] (*cf.* paragraph 4.2.1) (like HTTP 301 Moved Permanently [18]) so the user is directed instantly to the new address, and links have a chance to be quickly and automatically updated (like search engines). Web server log files should be analysed to track broken links.

4.1.4. Meaningful Web addresses: Furthermore, short meaningful human-readable addresses are appreciated. For instance, http://www.example.com/cgi/index.cgi?st=1526&dp=31 is less explicit and often longer than http://www.example.com/biology/staff/John-Smith/ which can easily be read as "John Smith, member of biology staff of Example company". This approach is also beneficial for the quality of search engines indexation. The character set should be Unicode UTF-8 [7]; this is important if there are other characters than ASCII [5]. In any case, the address is always encoded with the URI %HH escaping mechanism [10].
Addresses are an important factor of trust, and especially the name of the site (DNS, Domain Name Server, www.example.com in the current example). The extension (.org .com .eu …) should also be carefully chosen [9]. It is recommended that the main Web site can be reached both from http://example.com and the traditional http://www.example.com .

4.1.5. Metadata: Searching the Web and finding relevant information is not always easy. This process should be helped by giving documents pertinent addresses, titles and subtitles, but also by including extra information, "metadata", such as keywords, authors, classification, etc. In addition to the basic metadata defined in the HTML specification, there are some attempts of standardisation of broader metadata, like the Dublin Core Metadata Initiative [23]. The W3C's P3P metadata (Platform for Privacy Preferences) [13] is important to improve user confidence, since it makes clear the privacy policies in place on a specific Web site (e.g.: cookies, personal data collection, type of data). Another metadata set is the W3C's PICS (Platform for Internet Content Selection) [14] that enable the user to customise automatic filtering of Web sites that could be offending (sex-related, etc.). Metadata format should be checked, manually or automatically, against a standard that is better chosen at the early stages of a new Web site.

4.1.6. Semantics: Providing users with semantically-rich alternative formats, such as a description of the latest news of the Web site in a RSS file [12] (possibly with the RDF+XML framework [11]) or other ontologies, is a real bonus for accessibility, since this content is designed to be automatically understood and easily transformed for the final user. Some of those formats are already well known, like RSS, which has spread over the Web.

4.2. Standard protocols and formats

4.2.1. Communication protocol: The lowest layer of interest in this document is HTTP (Hypertext Transfer Protocol) [8], which is codifying the dialog between the client device and the Web server and which is not always well known by Web masters. Classic static documents are normally handled correctly by the Web server, if set up correctly. But one should pay more attention to dynamic Web pages, where a part of this work is transferred to the Web master, who does not always implement advanced HTTP concepts like date of last modification, negotiation and caching, which are, however, especially useful for devices with limited bandwidth, and various software tools.
Among other things, HTTP is also used to convey information about the type of document (MIME type [2]), character coding (*cf.* paragraph 4.1.2) and for addresses redirection (*cf.* paragraph 4.1.3). Those are points to check with any HTTP header analysis tool [64].

4.2.2. Document content: HTML (HyperText Markup Language) [1] is the standard to use when publishing text documents on the Web. HTML is a text-based markup language, like this: `<p>this is an <strong>important</strong> example</p>`. The HTML source code is human-readable. Even if the final user usually only sees the rendering of the HTML page in his Web browser, it is possible to go back to the source code (especially with basic IT skills becoming more common); it is therefore a plus to provide clean, readable source code.
HTML offers a variety of tags, used to structure the text. The Web master should pay attention to using the most appropriate ones, avoiding generic ones, to clearly identifying titles, subtitles, lists, definitions, etc. A rough standalone HTML page using only the default presentation rules (no CSS, *cf.* paragraph 4.2.3) should have an acceptable display. A draft of HTML accessibility techniques is being developed at the W3C [36].
Since 1995, several HTML versions have been released. Some of them have become obsolete, but others are targeted to various uses. Today, "XHTML 1.0 Strict" should be chosen in most cases and should ensure that many essential accessibility points are *de facto* covered.
HTML pages must be checked against a validation tool, such as the W3C Markup Validation Service [60], and tested in several Web browsers, in 'standard' mode (not 'quirks') [24].

4.2.3. Presentation layout: CSS (Cascading Style Sheets) [3] is a standard language to describe a layout. CSS instructions should be separated from the HTML body of text (*cf.* paragraph 4.1.1). This offers the possibility to display the rough Web document without any extra design information. The rough document should be easy to read and to navigate, and most of the functionalities should be available; this insures a minimum of accessibility. Furthermore, the user can override some of the CSS rules, like colours and shape of links, background, font, etc. This is mainly targeted to users with specific requirements. Web masters should therefore not rely on the design to make available the various functionalities of the Web site.
Whenever possible, the Web master should provide CSS alternatives, optimised for different types of media (screen, printer, handheld, …) and users (default, high contrast, large fonts, …).
CSS does not natively ensure that a layout will be highly accessible, and some specific accessibility rules must be followed (*cf.* W3C's draft of CSS accessibility techniques [37]). For example, using proportional font size, together with an adaptive layout, allows the user to change the text size or the dimensions of the window without violating the design and the usability of the Web site, and without having to introduce both horizontal and vertical scrollbars. More generally, all the design ergonomics and usability rules apply at this level, such as the uses of colours, etc. Finally, CSS instructions must be checked against a validation tool, such as the W3C CSS Validation Service [61], and tested in several Web browsers.

4.2.4. Dynamic pages: Dynamic behaviours, animations, form validation, etc. can be done on Web pages with a client side programming language: ECMAScript, the standardised version of JavaScript [4] (nothing to do with Java). Whenever possible, for design purposes, CSS should be used instead of JavaScript. Like for CSS, it is better to keep JavaScript code separated from the text, and Web pages should be functional with JavaScript disabled. A larger set of accessibility techniques, for client-side scripting, is being developed at the W3C [38]
The Web master should be careful not to break the HTML structure with JavaScript, so that the rendering mode can still be 'standard' and do not fall back to 'quirks' mode [24]. During development and validation of JavaScript code, proper debugging tools should be used, like Mozilla's JavaScript console and debugger [63]. Here again, tests should be made in various Web browsers, with all the warnings activated.

4.2.5. Multimedia content: Text content is not all, and multimedia takes a big part on Internet. Discussing accessibility and standards for multimedia contents is too large a subject to be reported here in detail. However, the basic notions can be introduced. Other good practices are listed in the accessibility guidelines (*cf.* section 5), like providing an alternate text, a title and a description for pictures. Markup languages should be used when possible (MathML, SVG), instead, or in addition, of other graphic-based solutions. Standard and/or open formats should be chosen whenever possible, instead of proprietary formats; they should be available on many systems, with minimal fees for clients. For images, standard PNG [70] should be used for synthetic images (graphics, line drawing, text, etc.), lossless compression, or advanced transparency needs. JPEG/JFIF [71] can be used for photographic pictures, with lossy compression. Video formats are less established; the Moving Picture Experts Group (ISO/IEC) [72] proposes some formats suitable for Internet, like MPEG-1 (widely supported, high compression, for small videos) or MPEG-4 (better quality/size ratio, for longer and larger videos). Unfortunately, MPEG standards are not free of charge in countries where software patents apply. XviD [73] is an Open Source free implementation of MPEG-4. Similarly, for sounds on Internet, the most popular format proposed by MPEG is the MP3 (MPEG-1 Audio Layer 3); and the Open Source community often uses the free "Ogg Vorbis" format [74].

4.2.6. Plug-ins and other formats: Many other formats are competing on the Internet, under the form of various plug-ins. Each format has its own accessibility features and recommendations. Some of those formats are open and royalty-free, such as PDF [75] that can be used in addition to HTML pages, to provide complex and precise printable versions, not achievable with CSS. Proprietary formats and plug-ins should be restricted to a minimal usage, for very specific use. Among other problems, installing a plug-in from a third party is a potential safety breach. When requiring a plug-in, a link to an official place from which to download the required software should be provided and which should then contain a policy declaration about privacy, advertisement intrusions, licence, legal aspects, etc.

5. Content accessibility guidelines

This section is the core of the current document. However, it is only when the architecture and the standard formats used by a given Web site have been verified that it is possible to focus on accessibility rules. Indeed, a good application of subsections 4.1 and 4.2 will cover a part of the accessibility rules. Furthermore, verification with automatic accessibility tools, or even manually, cannot be accurate if the documents are not valid.

In order to evaluate a Web site, against the W3C's accessibility rules, one should first read the W3C's **Web Content Accessibility Guidelines [30]**, in order to understand the various points that are to be checked. Then, a **checklist of checkpoints [31]** can be used in practice.

The checkpoints are ordered in three levels of priority, from A-level (minimal accessibility, all points must be satisfied) to AAA-level (high accessibility, some points may be addressed). Depending on the results, a logo (A, AA, or AAA) [42] can be claimed. It is not enough to check the home page; all the pages (or type of pages, when using templates) must be evaluated, and in case some areas of the Web site are less accessible than others, the scope of conformance should be reported, especially when using the logos.

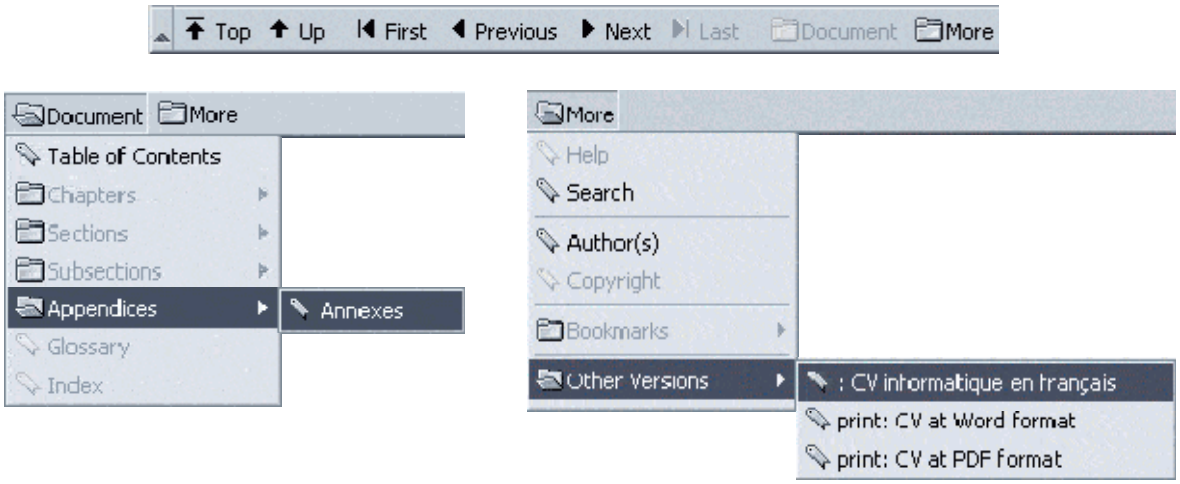
In addition to the current official guidelines (WCAG 1.0 [30]), it is already possible to refer to a larger working draft of the version 2.0 (WCAG 2.0 [30]), as well as specific accessibility techniques for HTML [36] (*cf.* paragraph 4.2.2), for CSS [37] (*cf.* paragraph 4.2.3), and client-side scripting [38] (*cf.* paragraph 4.2.4).

Since the current W3C's checklist does not cover all the possible good practices, some other suggestions are reported here, mainly pointing to other references.

5.1. Localisation issues: Being ready for internationalisation is always important, even if no translation to other languages is expected. Unicode is a first step, and following internationalisation authoring techniques [35] a second, but localisation is broader than those technical considerations. As an example, the date format issue: in an English text, 07/06/05 can be 7th of June 2005, but also 6th of July 2005 (USA style); the ISO-8601 standard proposes 2005-06-07, among other unambiguous solutions. Time formats and calendars, number and currency formatting, alphabetical sorting, etc. are related issues. Addressing those points is important to avoid ambiguities.

5.2. Navigation: Browsing a Web site is not always trivial, especially when visiting it for the first time. The W3C's checklist asks the developer to provide a navigation bar (priority 3, #13.5) and to add semantic information to pages and sites (priority 2, #13.2). An easy and efficient method to satisfy part of those two criteria simultaneously is to use the native HTML document relationships mechanism "LINK" [17], which offers a standard navigation bar for classic links, like "up", "previous", "next", "chapters", "table of contents", "glossary", "help", "search", "alternative versions", etc. This functionality is implemented in various browsers with a toolbar.

Example of such a navigation bar, in Mozilla browser [83]:



Since this toolbar is part of the user's browser, it will be consistent from one Web site to another, which makes it easier to learn. It also enables implementing shortcuts for the main navigation links, which can be used with various modalities, according to the user's needs, like keyboard, mouse gestures, voice commands, etc. For instance, some of this is implemented in the Opera Web browser [84].

5.3. Accessibility audits: It is possible to use services from accessibility experts, who can check and improve a Web site. They are, of course, more impartial and accurate when made by an independent team, different from the one that builds the Web site. There are also some good automatic software tools, like Watchfire WebXACT [62], which can do a part of the job, and which have their own W3C guidelines [33] as well. In addition, there are many software tools, to help in making Web documents accessible to a certain type of users, like for colour-blindness [50].

5.4. Toward perfect accessibility: Building a list of all the good Web practices, both from a technical, standard, and accessibility point of view, is a Herculean task. Even if some groups have started to build such a list [51], it is not possible in practice to follow all the secondary recommendations. There are also many resources about general accessibility, which can be applied to Web contents. This profusion of recommendation illustrates that the prioritized approach of the W3C's guidelines is pragmatic and efficient.

6. The law

In order to give accessibility recommendations more impact, several countries have issued some resolutions or even laws to ensure that those good practices can be widely adopted. A list of legal resources by country is maintained on the W3C WAI Web site [41].

Here are four examples where Web accessibility is explicitly codified:

▪ USA: US Public Law PL 105-220 of August 7, 1998. Section 508, amendment to the Rehabilitation Act of 1973 [43]. The WAI recommendations were considered when writing this amendment. It is an effective enforceable law, with financial penalties when transgressed.

▪ Europe: Parliament Resolution P5_TAPROV(2002)0325 of 13 June 2002 on the Commission communication eEurope 2002: Accessibility of Public Web sites and their Content [44]. This is already in place, as described, for example, in the accessibility statement of the European commission's Web site about Information Society Technologies [46].

▪ Italy: The Italian Parliament Act of 9 January 2004 (L 4/2004) describes measures to facilitate the access of disabled people to informatics resources, including references to the related European Parliament resolution as well as international standards, and will be updated periodically (article 12) [47].

▪ France: The European Parliament Resolution has been implemented into French law (2005-102), 11 February 2005, article 47 [48]. "International Internet accessibility rules must be applied to online public communication services". "Public Web sites older than February 2005 have 3 year to fulfil the rules". Some regional administrations have applied this law, with even more strict and exhaustive criteria [49].

7. Limitations

While it is typically easy to make Web content accessible, there are nevertheless some limitations. Here are some of them.

7.1. Arts and entertainment

Electronic content that aims to be artistic, funny or challenging is often more difficult to make accessible. In this case, it is even possible to argue that less-accessible content is superior. The challenge is indeed an important factor when designing games that will keep people interested for a long time, and that can also be the case for some Web sites. In such circumstances, it is helpful to provide a separate document describing the content.
Similarly, literature content might suffer if the author has to stick to basic words and expressions. As an example, the free collaborative encyclopaedia Wikipedia [81] contains a subset of articles in "simple English" [82], even if the "normal English" articles try to be understandable by most English speakers.

7.2. Turing anti-robot tests

On the Internet it is often necessary to automatically "tell computers and humans apart" (Captcha, [80]), in order to prevent software robots from accessing some areas of a Web site. A common type of test is a so-called CAPTCHA test, where the acronym stands for "**C**ompletely **A**utomated **P**ublic **T**uring test to tell **C**omputers and **H**umans **A**part". Tests of this type are often based on some visually distorted text or association of ideas between photos or pictures.

However, it is difficult to make them accessible without becoming too easy for a computer to solve. For this type of tests, accessibility can be increased by providing at least another type of test, (e.g.: one visual, one with sound). Other approaches are possible, but more cumbersome, with various biometrics or electronic identification, like credit cards [39].

7.3. Ongoing work and future solutions

7.3.1. HTML improvements: Current HTML specifications define a very limited set of widgets. Those are very basic, with little possible customisation. For instance, it is not currently possible to design a form with complex selection menus, or text-inputs enforcing a defined format, without using client side programming like JavaScript (*cf.* paragraph 4.2.4). This fact can rapidly raise some accessibility issues. In order to extend native HTML interaction capabilities, there are some proposed formats such as "Web Forms 2.0" [26] and, in a longer term, the W3C XForms [25], which seek to improve functionalities as well as semantics and accessibility, of Web forms.

7.3.2. Device independence: Accessibility rules are helpful for having one single good and accessible version of a Web document, and while this approach important, it has some limitations. Therefore, in addition to the accessibility rules, there is some ongoing work to facilitate the dialog between the user devices and the server of documents, to provide more personalised versions of the documents. The Device Independence [21] working group is in charge of this topic at the W3C, and has issued recommendations like CC/PP (Composite Capabilities/Preference Profiles) [15], but so far they have not become widely used.

8. Conclusion

Web accessibility is a large topic, and while one cannot ask each Web master to comply with all the standards and accessibility rules, having a clear common target is valuable. As has been described in this paper, Web accessibility is partly promoted and rooted in services that are targeted at disabled people, but, in a generalised setting, targeted as well at any possible user. Emerging technologies with multimodal interaction [22], such as the addition of vocal capacities [16], are both a challenge and an opportunity for the future of Web accessibility.

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