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(Revision of IEEE Std 2001-1999)

2001™

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IEEE Computer Society

Sponsored by the
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Sponsor

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of the
IEEE Computer Society

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Abstract: Recommended practices for World Wide Web page engineering for Intranet and Extranet environments, based on World Wide Web Consortium (W3C®) and related industry guidelines, are defined in this recommended practice. This recommended practice does not address stylistic considerations or human-factors considerations in web page design beyond limitations that reflect good engineering practice.
Keywords: Extranet, Internet, Intranet, Web page, Web site, Web site engineering, Web site life cycle, Web site management, well-engineered Web page, World Wide Web

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Introduction

(This introduction is not part of IEEE Std 2001-2002, IEEE Recommended Practice for the Internet—Web Site Engineering, Web Site Management, and Web Site Life Cycle.)

The World Wide Web is expanding and its value is increasing as a method for locating and delivering information. This creates a significant engineering challenge. Locating applicable information requires that indexing information be incorporated into Web page development. Once an applicable page has been located, essential information may not be present, resulting in user frustration and a failure of the Web application to meet its purpose.

This is a revision of the 1999 accumulation of Web site management "recommended practices." This revision is based on IEEE Std 2001-1999, extending it based on recommendations since it was developed, addressing "site-wide" issues as well as "managed" Web sites (as opposed to just Intranet and Extranet sites). These can serve to improve the effectiveness of Web pages for users, Web page developers, and the value of the Web in corporate and organizational applications. This recommended practice is focused on managed Web sites, Intranet (within an organization), and Extranet (between a group of collaborating organizations). Other projects are being evaluated by the Internet Best Practices working group (IBPwg) within the IEEE Computer Society. See http://dx.doi.org/10.1041/standard/2001 for current details.

Web page engineering often is done with little consideration for the immediate or ongoing implications of Web site design or implementation. Some sites reflect "state of the art" delivery that can only be accessed with the most recent tools. This may be inconsistent with the business objectives for that site. Some sites will languish beyond their applicable life, occupying valuable resources (particularly as these are incorporated into organizational indexes, and delivered as prospective "query returns" by indexing and search services). Poor Web page engineering results in lost productivity and user frustration, and can result in legal liabilities.

There is no clear prediction of when the World Wide Web or a specific site will be obsolete. There is a legitimate engineering concern that this lifespan may be significantly underestimated or disregarded entirely in many Web site designs. Vendor products—past and future versions, format preferences, or selection of implementation languages—may require future re-engineering as vendors and products fade. Corporate Web sites may not need to live beyond the life of the corporation, however, public sector and other institutional sites may well span centuries. A significant portion of the content of these sites may not require updating, except in cases of shortsighted design. The Magna Carta and the works of Shakespeare are examples of fairly stable content.

The recommended practices and requirements set forth in this recommended practice are aimed to reduce the risks associated with Web page investments. Further revision of this recommended practice is expected, partially to reflect changes in the Web environment, but also to reflect increased understanding of "recommended practices" in Web page engineering. There is a popular awareness of "Web years," characterized by rapid advances in the platform technology for clients and servers. There is a potentially expensive, misinformed conclusion that might be drawn from this, which is that Web pages (and more directly, information content and services delivery) either are, or should, move forward at this same rate. Some of today's Web pages will warrant long-term retention, and within the context of business operations (which is the core of managed sites), re-engineering of last year's Web pages is an investment that requires justification. The value of Web-based operations is the delivery of the right information and services to the right persons at the right time with the least amount of effort. Success in Web-based operations is based more on engineering design in response to an understanding of the target-user community and information, than it is on the rapidly evolving technology for Web platforms.

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IEEE Recommended Practice for the Internet—Web Site Engineering, Web Site Management, and Web Site Life Cycle

1. Overview

This recommended practice provides guidance for designing and implementing well-engineered Web pages for use in managed Web sites. The goal of this recommended practice is to improve the productivity of managed Web operations in terms of:

a) locating relevant information,
b) facilitating ease of use,
c) reducing legal liabilities, and
d) providing for efficient development and maintenance practices.

This recommended practice will focus on vendor- and product-independent considerations.

This recommended practice provides guidance for persons designing and developing Web pages, and managers responsible for establishing guidelines for Web site development.

1.1 Scope

This document defines recommended practices for World Wide Web page engineering for Intranet and Extranet environments, based on World Wide Web Consortium (W3C®) and related industry guidelines.

This recommended practice does not address stylistic considerations or human-factors considerations in Web page design beyond limitations that reflect good engineering practice. Annex B contains topics which are not sufficiently mature or where there are not specific recommendations for inclusion in the current issue of this recommended practice.

1.2 Purpose

This recommended practice is intended to provide guidance to Web page developers in Intranet (organizational internal), and Extranet (amongst a limited domain of organizational participants) Web environments on recommended practices for Web page engineering. The objective is to improve the productivity of Intranet/Extranet Web operations in terms of locating relevant information, and efficient development and maintenance practices.

The 2002 revision of this recommended practice addresses items identified in Annex A of IEEE Std 2001-1999 [B14][1] which can be well-defined and to respond to emerging technology and changes in practice that have resulted in new material or changes to approved recommendations. Conformance to this recommended practice in developing and publishing a Web site provides a basis for a well-engineered Web site.

[1]The numbers in brackets correspond to those of the bibliography in Annex A.

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1.3 Conformance

This recommended practice defines two forms of conformance: "IEEE Std 2001-2002-conforming Web page" and "IEEE Std 2001-2002-conforming Web page generation tool." Throughout this recommended practice, the use of the verb *shall* indicates a requirement of the standard; the use of the verb *should* indicates a recommendation; and the use of the verb *may* indicates an option or variation that is permitted by the recommended practice. Although users of this recommended practice are strongly encouraged to consider the recommendations made within, the implementation of recommendations is not a requirement of Web page conformance.

1.3.1 IEEE Std 2001-2002-conforming Web page

A conforming Web page implements all the requirements of this recommended practice. A Web page that conforms to this recommended practice may indicate this by the use of the following tag:

```
<span class="IEEEstd2001">

      <a href= "http://dx.doi.org/10.1041/standard/2001/2002/logo/use"

           <img src= "http://dx.doi.org/10.1041/standard/2001/2002/logo"

           alt="IEEE Computer Society Best Practices axV2 Logo"

           width="80" height="40" />

      </a>

</span>
```

NOTE—The HTML Reference Designator (HREF value will change with each version of this recommended practice. Tools should use the HREF value to determine the version of the standard being used.

The image file may be downloaded and referenced using relative Uniform Resource Identifiers (URIs), but the target HTML file must be referenced by an absolute URI.

Consistent with 4.1.10 of this recommended practice, a meta statement indicating conformance to this recommended practice may be included. This statement is:

```
"<meta name="guideline" content="computer.org/2001/2002" />
```

1.3.2 IEEE Std 2001-2002-conforming Web page generation tool

A product for generating well-engineered Web pages dynamically, or as an authoring tool, conforms to IEEE Std 2001-2002 if it satisfies all of the following conditions:

a) It generates pages that conform to the XHTML DTD recommendation of the W3C, or it documents which DTDs it supports.
b) It generates pages which comply with the DTD selection of the user.
c) For versions HTML 3.2 and higher, or XML; it supports Cascading Style Sheets (CSS) 1.0 or higher, or it supports XSL and, in either case, it documents the use of this function and identifies which recommendations are supported.
d) It generates pages that conform to all of the requirements, recommendations, and options of this recommended practice. Tools may allow for creation of non-conforming pages as a user option (in which case the IEEE 2001 tag cannot be included on the page.)
e) It supports the Web Consortium's Authoring Tool Accessibility Guidelines (see 2.8).

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2. References

This recommended practice shall be used in conjunction with the following publications. When the following specifications are superseded by an approved revision, the revision shall apply. See Annex A for informative bibliographic references. Uniform Resource Locators (URLs) provided in this recommended practice are current as of the date submitted for publication[2]. See http://dx.doi.org/10.1041/standard/2001/2002/references for a list of normative and informative reference URLs on-line.

36 CFR 1194 –Electronic and Information Technology Accessibility Standards, Federal Register Dec. 21, 2000; Code of Federal Regulations (CFR).[3]

Authoring Tool Accessibility Guidelines 1.0, W3C Recommendation 3 February 2000, Guidelines required by Web page generation tools to support accessibility requirements.[4]

HTML 4.01 Specification, W3C Recommendation 24 December 1999.[5, 6]

ISO 639-1:2002, Codes for the Representation of Names of Languages—Part 1: Alpha-2 Code.[7]

ISO 639-2:1998, Codes for the Representation of Names of Languages—Part 2: Alpha-3 Code.

ISO 3166-1:1997, Codes for the Representation of Names of Countries and their Subdivisions—Part 1: Country Codes.

ISO 4217:2001, Codes for the Representation of Currencies and Funds.

W3C REC-CSS1-19900111, W3C Recommendation Cascading Style Sheets, level 1—W3C Recommendation, 17 Dec. 1996, revised 11 Jan 1999.[8, 9]

W3C REC-CSS2-19980512, W3C Recommendation Cascading Style Sheets, level 2 CSS2 Specification—W3C Recommendation, 12 May 1998.[10, 11]

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[2]If direct access to W3C recommendations is not possible, they can be located from the primary site: http://www.w3.org.

[3]For information on this document, please visit http://www.access-board.gov/sec508/508standards.htm.

[4]For information on this document, please visit http://www.w3.org/TR/ATAG10/.

[5]This specification defines the HyperText Markup Language (HTML), the publishing language of the World Wide Web. This specification defines HTML 4.01, which is an update of HTML 4. In addition to the text, multimedia, and hyperlink features of the previous versions of HTML (HTML 3.2 [HTML32]—see [B60]—and HTML 2.0—see [B20]), HTML 4 supports more multimedia options, scripting languages, style sheets, better printing facilities, and documents that are more accessible to users with disabilities. HTML 4 also takes great strides towards the internationalization of documents, with the goal of making the Web truly World Wide. HTML 4 is an SGML application conforming to ISO 8879:1986 [B43].

[6]For information on this document, please visit http://www.w3.org/TR/1999/REC-html401-19991224.

[7]ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iso.ch/). ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (http://www.ansi.org/).

[8]This document specifies level 1 of the Cascading Style Sheet (CSS1) mechanism. CSS1 is a simple style sheet mechanism that allows authors and readers to attach style (e.g., fonts, colors, and spacing) to HTML documents. The CSS1 language is human readable and writable, and expresses style in common desktop publishing terminology. One of the fundamental features of CSS is that style sheets cascade; authors can attach a preferred style sheet, while readers may have a personal style sheet to adjust for human or technological handicaps. The rules for resolving conflicts between different style sheets are defined in this specification.

[9]For information on this document, please visit http://www.w3.org/TR/REC-CSS1.

[10]This specification defines Cascading Style Sheets, level 2 (CSS2). CSS2 is a style sheet language that allows authors and users to attach style (e.g., fonts, spacing, and aural cues) to structured documents (e.g., HTML documents and XML applications). By separating the presentation style of documents from the content of documents, CSS2 simplifies Web authoring and site maintenance.

CSS2 builds on CSS1 and, with very few exceptions, all valid CSS1 style sheets are valid CSS2 style sheets. CSS2 supports media-specific style sheets so that authors may tailor the presentation of their documents to visual browsers, aural devices, printers, Braille devices, hand-held devices, etc. This specification also supports content positioning, downloadable fonts, table layout, features for internationalization, automatic counters and numbering, and some properties related to user interface.

[11]For information on this document, please visit http://www.w3.org/TR/REC-CSS2/.

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W3C WAI Web Content 19990505, W3C Recommendation Web Content Accessibility Guidelines 1.0, WAI Page Author Guidelines—W3C, 5 May1999.[12, 13]

XHTML™ 1.0: The Extensible HyperText Markup Language, A Reformulation of HTML 4 in XML 1.0, W3C Recommendation 26 January 2000.[14, 15]

3. Definitions, terminology, abbreviations and acronyms

3.1 Definitions

3.1.1 archival pages: On-line data that is 1) not expected to change, and 2) no longer maintained. This data also may not be readily renderable by future tools.

3.1.2 body metadata: Elements in the body of an HTML document providing administrative and/or navigational facilities for the user or administrator.

3.1.3 cookie {XE "Cookie definition of"}: A quantity used to indicate or signal to a recipient of data, significant changes in the state of the entity supplying the data. Web sites may store/retrieve cookies from user client systems to maintain state information including identification of users and transaction coherency.[16]

3.1.4 Extranet: A set of Intranets connected for specific objectives, spanning multiple organizations.

3.1.5 Intranet: A managed network operating strictly within an organization. More than one Intranet may exist within an organization, these may be isolated.

3.1.6 managed network: A network or set of networks established and controlled by one or more organizations to meet specific organizational or business needs.

3.1.7 managed Web site: A site created and maintained based on organizational guidelines.

3.1.8 mirror site: A duplicate copy of a master site maintained on a different host typically to provide redundancy, higher performance, or local access.

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[12]These guidelines explain how to make Web content accessible to people with disabilities. The guidelines are intended for all Web content developers (page authors and site designers) and for developers of authoring tools. The primary goal of these guidelines is to promote accessibility. However, following them will also make Web content more available to all users, whatever user agent they are using (e.g., desktop browser, voice browser, mobile phone, automobile-based personal computer, etc) or constraints they may be operating under (e.g., noisy surroundings, under- or over-illuminated rooms, in a hands-free environment, etc). Following these guidelines will also help people find information on the Web more quickly. These guidelines do not discourage content developers from using images, video, etc, but rather explain how to make multimedia content more accessible to a wide audience.

[13]For information on this document, please visit http://www.w3.org/TR/WCAG10.

[14]This specification defines XHTML 1.0, a reformulation of HTML 4 as an XML 1.0 application, and three DTDs corresponding to the ones defined by HTML 4. The semantics of the elements and their attributes are defined in the W3C Recommendation for HTML 4. These semantics provide the foundation for future extensibility of XHTML. Compatibility with existing HTML user agents is possible by following a small set of guidelines.

XHTML is a family of current and future document types and modules that reproduce, subset, and extend HTML 4.0. XHTML 1.0 provides the basis for a family of document types that will extend and subset XHTML, in order to support a wide range of new devices and applications, by defining modules and specifying a mechanism for combining these modules. This mechanism will enable the extension and subsetting of XHTML 1.0 in a uniform way through the definition of new modules.

[15]For information on this document, please visit http://www.w3.org/TR/xhtml1.

[16]W3C's Document Object Models (DOM) describe cookie operations within the Web document context. IETF RFC 2965:2000 [B23] describes a proposed standard for HTTP State Management based on the cookie concept.

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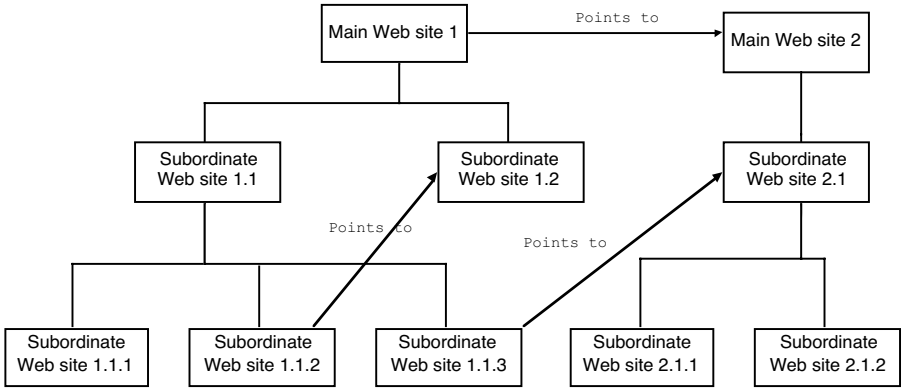
3.1.9 persistent URI: A Uniform Resource Identifier (URI) is persistent if it is a reference that does not need to change at the link in a document, and can still reach the desired object even though that object may have changed locations.

3.1.10 subordinate Web site: A site contained within another Web site.

3.1.11 Web page: A digital multimedia object as delivered to a client system. A Web page may be generated dynamically from the server side, and may incorporate applets or other elements active on either the client or server side.

3.1.12 Web site: A collection of logically connected Web pages managed as a single entity. A Web site may contain one or more subordinate Web sites. (See Figure 1 for a representative architecture that is possible for a collection of Web pages within a Web site.)



NOTE—All elements of this diagram may represent separately managed Web sites. Such management should reflect deference to the applicable policies of the organization hierarchy. Note that Web sites are not implicitly hierarchical, it is the organization hierarchy policies that may be relevant.

Figure 1—Example of a Web site architecture

3.1.13 well-engineered Web site: A Web site designed and implemented in accordance with the recommendations of IEEE Std 2001-2002.

NOTE—Frame, NoFrame and Robot are used based on the HTML 4.01 specification.

3.2 Terminology

This subclause describes terms used in a specific manner in this recommended practice. The descriptions are not intended as definitions, but rather as explanations of the special usage.

3.2.1 Rfield: The designation for a Web page segment presented within a well-engineered Web page, primarily for the human reader. Typically, the contents are not structured for machine interpretation.

3.2.2 Mfield: The designation for a Web page segment presented within a well-engineered Web page, in machine-readable format, which is not intended to be presented to the human reader.

3.2.3 RMfield: The designation for a Web page segment presented within a well-engineered Web page, structured for both machine interpretation and for presentation to the human reader.

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3.3 Abbreviations and acronyms

CSS	Cascading Style Sheets
CSS1	Cascading Style Sheets, level 1
CSS2	Cascading Style Sheets, level 2
DHTML	Dynamic HTML
DNS	Domain Name Service
DOI	Digital Object Identifier™
DTD	Document Type Definition (for XML or SGML specifications)
GIF	Graphics Interchange Format
HREF	HTML reference designator
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
IBPwg	Internet Best Practices Working Group
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPR	Intellectual Property Rights
ISBN	International Standard Book Numbers
JPEG	Joint Photographic Experts Group (image format)
NMG	Network Motion Graphics
PDA	Personal Digital Assistant
PICS	Platform for Internet Content Selection
PNG	Portable Network Graphics
RDF	Resource Definition Framework
SGML	Standard Generalized Markup Language
SI Units	International System of Units: the modern metric system
TCP	Transport Control Protocol
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Universal Resource Name
UTC	Coordinated Universal Time
WAI	Web Accessibility Initiative (W3C)
W3C	World Wide Web Consortium
XHTML	Extended HyperText Markup Language
XML	Extensible Markup Language

4. Design practices

The developer of a well-engineered Web site should prepare a project plan, or follow an existing plan, covering the entire life cycle of the well-engineered Web site, including development, maintenance, and retirement. The well-engineered Web site project plan shall incorporate consideration of the implications of both minimum and maximum Web site life expectancies.

The project plan should address Web site maintainability. The plan should address requirements for dates (see 7.4) and contact information (see 4.2.6 for privacy, 5.7 for Webmaster, and 5.11 for site center).

Some well-engineered Web pages have as a significant objective the delivery of specific information to individuals who need that information. Well-engineered Web sites shall have an identified set of metrics that can be evaluated. Ease of access to information by targeted-user communities is an example of one of the possible design goals.[17]

[17]For this example, usability testing would be a potential test methodology.

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Navigation aids, buttons, user readable body metadata, and other items commonly appearing on multiple well-engineered Web pages should be consistent across the site. The consistency shall include the common look and feel as well as a common location within the well-engineered Web page.[18]

This recommended practice should be reviewed, in its entirety, during the early part of the design stage to identify all factors that need to be considered for the design, development, and maintenance of a well-engineered Web site.

Design shall take into consideration the characteristics of the client and server environment. Failure to do this may interfere with access to the presented material by some of the target-user community. Plans should include contingencies for technical obsolescence and growth.

Test cases shall be designed considering the user interaction with the Web site. Some testing effort shall stress performance and scalability features supported by servers that will be used when the site is in operation.

Recommended security practices for connecting to the Internet are being defined in a draft IEEE Standard which currently has a proposed designation of 2002. These recommended practices for Internet operations are also applicable for Intranets and Extranets. Well-engineered Web site design shall consider the recommended security practices contained in IEEE Project 2002 once it is published as an approved IEEE Standard.

If a well-engineered Web site is complex or if it implements interactive functionality, it may be useful to consider it as a software product and to apply appropriate standards for software development and maintenance. Several IEEE standards may be useful in this regard:

a) IEEE/EIA Std 12207.0-1996 [B15] prescribes processes useful throughout the entire software life cycle including development, operations, and maintenance.
b) IEEE/EIA Std 12207.1-1997 [B16] describes minimum data that should be recorded for the purposes of producing documentation.
c) IEEE Std 829-1998 [B4] provides material helpful in test planning, specification, and reporting.
d) IEEE Std 830-1998 [B5].
e) IEEE Std 1016-1998 [B7] provides the necessary information and recommendations for the design description of software.
f) IEEE Std 1028-1997 [B8] explains the conduct of design reviews.
g) IEEE Std 1058-1998 [B9] provides requirements for the management of software projects.
h) IEEE Std 1074-1997 [B10].
i) IEEE Std 1490-1998 [B13].

NOTE—Additional standards are listed in Annex A.

4.1 General requirements

4.1.1 Target-user community

A Web site may address one or more diverse sets of users. Designers shall identify and document one or more targeted user communities. Representatives of these communities, which may include persons with disabilities, should be included in the design process and the ongoing evaluation of the site.

[18]Common location, look, and feel can be tested by visual inspection or focus group evaluation.

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The evaluation shall include the client environments of these target-user communities. Diversity of browsers in use, complementary capabilities (e.g., script, byte code, graphics, etc), and the bandwidth of connectivity shall be included in this environmental evaluation. The target-user community may have a wide diversity of display devices and/or selected presentation formats within the display windows; this may establish some presentation constraints (consider displaying Web pages to pocket devices, etc).

The selection of implementation tools (e.g., servers, generators, and selected "levels" of HTML, CSS, XML, scripting, etc) shall be based on this evaluation of the target-client communities. The site should be monitored to determine changes in client environment that could affect the Web site design.

The designer shall document the targeted environment range for the Web site for future reference. It may be advantageous to establish documentation or specifications applicable to the Web pages for an entire network, and encourage or enforce conformance to these. The documentation shall include statements about the page formats generated, including HTML version (and in some cases excluded functionality), CSS version, XML version and XML DTD(s), graphics formats, scripting and/or byte code executable versions and/or limitations, human-language considerations (as well as character sets), bandwidth considerations, and other characteristics from this recommended practice or as identified during the design phase. The documentation should be updated based on actual experience. Specification in terms of vendor-specific products should be avoided along with the associated loss of product independence.

4.1.2 Key information to convey

The delivery of the information to the user is the primary purpose of a Web site. Comprehension and navigation are key engineering design considerations. Non-textual information (e.g. video, graphics, audio) can consume significant bandwidth, but can also provide advantages in delivering information in a coherent and easily comprehended way. The low bandwidth environments of some users, the inclusion of an option for text-only delivery, adaptation for the visually impaired, and delivery in multiple languages are issues that should all be considered.

Well-engineered Web site design may segment information contents by expiration and/or revision date and incorporate this into the overall Web site design. Well-engineered Web site design shall include a clear way to identify the areas changed without the need for navigating the whole site. The segmentation should be at the page level. A policy for the expiration of the changed-pages list should be described.

Some information has a limited useful life. Stock quotes, telephone directories, product specifications, organizational charters, and archival background information change at different rates. The nature of the information and the need of the user to have "current" information affects the contents of well-engineered Web pages, as well as the methods used to deliver these pages.

4.1.3 Expected results

Metrics for evaluation of well-engineered Web sites shall be derived from evaluation by the target-user community and information to be conveyed. Simplistic "hit rate" metrics may not be sufficient unless well-engineered Web pages for low-bandwidth or text-only users are being compared to equivalent well-engineered Web pages. A representative metric may be the measurement of the time or the number of keystrokes required of the user community to arrive at the desired end page.

Organizational effectiveness, competitive success, and even meeting legal obligations and liabilities can depend on timely access to critical information within an organization. Intranet/Extranet design should consider this, particularly as it is used to displace other methods for information delivery. User feedback should be actively sought as part of this process.

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4.1.4 Life cycle

Web pages, Web sites, and Web projects have a lifetime—a life cycle. The well-engineered Web site developer should estimate the duration of the life cycle and should plan for well-engineered Web site maintenance during its active life cycle. Some well-engineered Web pages will be "permanent archival" material, with little maintenance, and with an unbounded life span.

The well-engineered Web site project plan, if prepared, shall document requirements for scheduled well-engineered Web site maintenance and/or well-engineered Web site expiration. Some well-engineered Web pages will require ongoing maintenance (for example, due to a legal or regulatory mandate).

Permanent archival content should be implemented following strict adherence to standards and minimal dependence on vendor-specific or immature technology. This will facilitate access over an extended period of time, and minimize maintenance requirements.

4.1.5 Life cycle management

In some cases, a well-engineered Web site may approach the complexity of a software project, particularly if the site implements interactive functionality. In these cases, one or more projects should be initiated to execute the responsibility to plan and manage the well-engineered Web site throughout its entire life cycle from conception through retirement. The software life cycle processes of IEEE/EIA Std 12207.0-1996 [B15] should be considered for acquisition, supply, development, operation, and maintenance of well-engineered Web sites.

4.1.6 Web site life cycle plan

A plan should be prepared for managing appropriate life cycle processes for the Web site—acquisition, supply, development, operation, and maintenance. The plan for the Web site should define when, how, and by whom specific activities are to be performed, including options and alternatives, as appropriate. The plan should include, at least, the following generic items:

a) Date of issue and status
b) Scope
c) Issuing organization
d) References
e) Approval authority
f) Planned activities and tasks
g) Macro references (policies or laws that give rise to the need for this plan)
h) Micro references (other plans or task descriptions that elaborate details of this plan)
i) Schedules
j) Estimates
k) Resources and their allocation
l) Responsibilities and authority
m) Risks
n) Quality control measures
o) Cost
p) Interfaces among parties involved
q) Environment/infrastructure (including safety needs)
r) Training
s) Glossary
t) Change procedures and history
u) User support needs (help desk, end-user documentation, telephone line)
v) Target community descriptions

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NOTE—The items of this plan are quoted from subclause 5.2 of IEEE/EIA Std 12207.1-1997 [B16]. The architects of complex well-engineered Web site projects may wish to consider more detailed plans described elsewhere in IEEE/EIA Std 12207.1-1997 [B16]. The developers of complex well-engineered Web site projects may also wish to consider the use of IEEE Std 1058-1998 [B9].

4.1.7 Well-engineered Web site requirements specification

A requirements specification should be prepared for a well-engineered Web site. This specification should include, at least, the following generic items:

a) Date of issue and status
b) Scope
c) Issuing organization
d) References
e) Approval authority
f) Body
g) Delivery instructions
h) Assurance requirements
i) Conditions, constraints, and characteristics
j) Glossary
k) Change history

NOTE—The items of this specification are quoted from subclause 5.7 of IEEE/EIA 12207.1-1997 [B16]. The architects of complex well-engineered Web site projects may wish to consider more detailed specifications described elsewhere in IEEE/EIA 12207.1-1997 [B16]. The developers of complex well-engineered Web site projects may also wish to consider the use of IEEE Std 830-1998 [B5].

4.1.8 Well-engineered Web site design description

A design description should be prepared for the Well-engineered Web site. The design description for the Well-engineered Web site should include, at least, the following generic items:

a) Date of issue and status
b) Scope
c) Issuing organization
d) References
e) Context
f) Notation for description
g) Body
h) Summary
i) Glossary
j) Change history

NOTE—The items of this plan are quoted from subclause 5.1 of IEEE/EIA 12207.1-1997 [B16]. The architects of complex well-engineered Web site projects may wish to consider more detailed descriptions described elsewhere in IEEE/EIA 12207.1-1997 [B16]. The developers of complex well-engineered Web site projects may also wish to consider the use of IEEE Std 1016-1998 [B7].

4.1.9 Design review

Web page designs should be subjected to design reviews in keeping with good engineering practices. Depending on the value and expected impact of specific well-engineered Web site, additional reviews may be warranted. The design review subject matter may include evaluations of the graphical design, legal implications, cultural impacts, linguistic review, market research, accessibility and usability. The design review should span the entire range of functional objectives, technical capabilities and constraints throughout the system. The review should also address the capabilities and limitations of the target user community. The

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insertion of new technology into the system requires the widest range of reviewer experience. In addition, the content should be subjected to review by applicable experts and other users.

NOTE—IEEE Std 1028-1997 [B8] describes how to conduct design reviews.

4.1.10 Proofreading and quality objectives and testing

Quality assurance should be part of site planning and development. The project plan should indicate specific tools and processes to be used during implementation to assure the quality objectives are met.

Well-engineered Web pages should be subjected to proofreading and quality assurance. Proofreading should involve the use of the full range of browsers, screen resolutions, and browser window sizes and shapes. Final assessments must be done on the object(s) (text, graphics, layout, navigation, multimedia, etc) as delivered to client device(s), and not assume that generation tools will convert the source accurately. Proofreading shall be applied to static as well as dynamically generated pages.

The quality assurance process should validate that the presentation meets all the objectives and requirements of this recommended practice and other applicable standards. It should also validate the user requirements. Quality assurance shall be applied to static as well as dynamically generated pages.

Validation testing should be pursued in at least two distinct phases: development testing and operational testing. Development (component) testing should be conducted as part of the implementation process.

Development testing of well-engineered Web sites shall be designed to address issues such as:

a) Well-engineered Web pages shall display as designed.
b) Scrolling requirements shall be sensitive to the type of information being conveyed.
c) Well-engineered Web sites shall provide security controls such as passwords and firewalls if required.
d) Well-engineered Web pages shall be tested for conformance to this recommended practice using a verification tool to verify compliance where appropriate

Operational testing should be conducted using the support of the members of the intended user community. Operational testing of well-engineered Web sites shall be designed to address issues such as:

a) Well-engineered Web pages shall display as intended.
b) Well-engineered Web pages shall not require excessive scrolling.
c) Well-engineered Web sites shall provide required security controls.
d) Well-engineered Web pages shall be tested for conformance to accessibility requirements.
e) Well-engineered Web pages should render a reasonable printout or offer an alternative method of print output.
f) The Web site shall meet all defined user requirements. New user requirements that evolve from design initiation through final delivery shall be documented.
g) All links shall work correctly.

NOTE—IEEE Std 829-1998 [B4] provides material helpful in test planning, test specification, and test reporting.

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4.1.11 Managed pages

Managed pages shall include one or more meta tags indicating the guidelines or standards applicable to this page. The format for the meta tag shall be "`<meta name="guideline" content=URI of guideline />.`" Said URI should be a unique identifier for a specific version of a guideline which might not resolve to an actual document. Pages conforming to this standard may include the meta tag designated in 1.3.1. This will facilitate site management against selected guidelines, and also target client selection of conforming pages.

4.2 Environment selection

4.2.1 HTML version(s)

The version of HTML, and the features within that version of HTML, should be selected based on the client environment of the target-user community. For example, "frames" and Java scripts are representative of the elements that reflect significant design incompatibilities with older browser versions, and are examples of the type of feature that must be given critical evaluation in the design phase. Removal of an architectural feature like "frames" can require significant redesign. Web page developers should be familiar with XML and evaluate how, if, and when to incorporate XML into a well-engineered Web site.

As a default, new well-engineered Web pages should use XHTML in its HTML compatible form. Some of the XHTML compatible guidelines should be included in the well-engineered Web site project plan, even where older browser compatibility is required (for example, lowercase tags.)

Essential elements of XHTML compatibility:

a) All tag elements and attributes in lower case.[19]
b) Documents to be well formed, have properly nested elements and have end tags on all elements that have content (including `li`, `p`, etc). Empty elements to have a closing slash in the tag (e.g. `<br />` —note space before slash in this example for HTML compatibility).
c) All attribute values to be quoted.
d) Use '`id`' for fragment identifiers (in addition to `'name'` for HTML compatibility, e.g. `<a name="IEEE" id="IEEE">`).
e) Use '[CDATA[…]]' construct for enclosing script, style or other 'commented' elements (comment structures may be stripped by server during delivery process).
f) Avoid linebreaks or excess spaces in attribute values.
g) Do not include more than one '`isindex`' element in a page.
h) Include both '`lang`' and '`xml:lang`' values.
i) Include both 'xml' and 'http-equiv' character encoding statements.
j) Specify ampersand as & in attribute values.
k) Be aware that CSS defines different conformance for XML and HTML.

4.2.2 Cascading style sheets (CSS)

Well-engineered Web pages shall separate the presentation from the content, to the extent that it is feasible. Style sheets should be used to accomplish this. The trade-off between accommodating a greater range of target-client browsers using page-specific characteristics and the maintenance advantage of page-independent presentation offered by style sheets, shall be included in well-engineered Web site design. The decision to use CSS should include evaluation of the capability of target user environments.

[19]Tools, including 'freeware' such as TIDY (at W3C site) exist to facilitate transformation of HTML pages into XHTML or partial transformations such as conversion to lowercase.

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A simple example is using color in Web pages. Explicit incorporation of color is one option; style sheet incorporation of color is another. The same color scheme can be applied to a diverse set of pages in a consistent way using a style sheet, reducing coding and maintenance effort. A change to the common style sheet, rather than changes to the many pages using that plan, can accomplish a change in the color scheme. Moreover, specific user communities may want or need to override the color selection put forward by the design (visual impairments for example), which is only viable with a mechanism such as cascading style sheets. Similarly, if hard-copy printing of a page is desirable, the CSS printer presentation style should be included.

Web page generation tools shall support CSS as an external style sheet, only using site-developer specified/selected ‘class’ (or ‘id’) attributes and avoiding the ‘important(!)’ designation so end-users can apply their own style sheets to match their preferences/requirements.

4.2.3 XML considerations

XML provides mechanisms for delineating document structure in ways that are responsive to business objectives. A well-formed HTML document is one instance of an XML document. XML provides for new tags that can be content specific, and facilitate automated processing of content. Within the HTML environment, XML-type structures should be designated with the id and class attributes, and potentially the `<span>` and `<div>` elements.

Within an HTML 4.0 document, `id` is defined as being unique, and can be used as an anchor for fragment links, whereas `class` can be duplicated many times within a document. Both `id` and `class` can be used to distinguish a page segment for style sheet presentation control (developers should verify that usage of 'class' and 'id' for style specification work for the targeted range of browsers).

Well-engineered Web sites may plan for the accommodation of a range of browsers identified in the target-user community client environment during the design planning process. This can be accomplished by identification of browser types and delivery of different sets of pages based on this, or by ensuring that the critical information content for a page can be effectively presented by the full range of browsers. Browser and version-specific dependencies should be avoided.

4.2.4 Physical characteristics

Consideration shall be given to the legacy and anticipated evolution of the user-community environment in terms of hardware and software capabilities. The rate of adoption of new technology at the consumer level often exceeds that of industry and the public sector. Similarly, consideration shall be given to anticipated or likely changes in technology to minimize the need to re-engineer Web sites to accommodate these changes. Some examples of devices that should be considered include:

a) Personal Digital Assistants (PDAs)
b) Video enhanced telephones
c) TV devices with Web interfaces
d) Braille display units
e) Access-specific and/or text-only devices
f) Wireless and mobile devices

Considerations should include screen display area (which can be quite small on some of these devices); latency of communications (e.g., satellite links, wireless channel bandwidth, etc); and, limited (or non-existent) local cache/storage. Similar considerations related to communications bandwidth and costs are required. U. S. communications tariffs are not exemplary of international practices. Limited bandwidth and “per minute” tariffs are common on an international basis and in the emerging mobile and radio communications environments.

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Protocols or protocol subsets to support this next generation of mobile devices may require additional consideration in selection of target protocols. Consideration should be given to the wireless applications protocol (WAP), and XHTML base protocol. Note that rapid expansion of low bandwidth wireless devices in the next few years may be a significant consideration in Web page design.

4.2.5 Scripting and executable considerations

Client side execution such as scripting may be refused by clients. Part of the design process shall include documenting when, if ever, such facilities will be used. Tools shall not include client-side scripting unless that option has been selected by the author. Note client environments may disable client execution or scripting for security reasons, therefore servers should be able to deliver information without scripting. Minimally, a site shall notify the user that scripting is required for some functions. Selection of specific tools or versions of implementations shall be considered in both the context of the target-client environments and the life cycle management of the well-engineered Web site. Where possible, standards-based environments that are platform (processor, operating system, and browser)-independent should be targeted (see also 4.3.1).

4.2.6 Privacy policies

Well-engineered Web site design should be governed by the legal and ethical guidelines of both the target-user community, and others with access to the pages. Privacy considerations shall include organizational policies, legal context (e.g., many European countries have very strict privacy laws), and an awareness of potential network integrity issues. Information associated with identifiable individuals and personal data such as phone numbers, home address, salary, and so forth are all subject to these considerations; and the requirements on these vary between jurisdictions, cultures, and national boundaries. Well-engineered Web sites shall address the range of access across jurisdictional boundaries in identifying the information to be provided and protections to be applied. Top-level pages should include links to applicable privacy policy statements.

All information collected from a user that would identify the user shall be discarded when the user terminates the session prior to the delivery of the prescribed item. It is acceptable to retain the data collected if the user accepts the retention of data (such as for return for later completion of the action) at the time the session is terminated. The user may be asked to allow retention of data, when the data to be collected from the user requires a significant input from the user. The information should be retained for a fixed length of time (such as one day) after which it must be discarded.

Anonymity shall be allowed upon user choice, with the potential of not providing the service or the information requested. Informative messages should be provided to explain the needs of the service and to exhibit some contact points for further clarification. End-user data collection (e.g., e-mail address, username, etc) shall not be gathered without explicit user consent. In some countries, this is related to legal issues.

It may be necessary to know the geographical location of the server (perhaps provided in metadata) and the client in order to determine what information can be provided. Legal jurisdictions and industry segments are formulating privacy guidelines that may require consideration of both at the time of design, and when reviewed, as conditions change.

Well-engineered Web site shall follow legal and industry guidelines on the collection, notification, and retention of information related to users. Annex F contains pointers to principles for privacy from the European Union, U. S. Dept. of Commerce (Safe Harbor), U. S. Federal Trade Commission (COPPA)[20], and the Organization for Economic Cooperation and Development (OECD) guidelines.

[20]COPPA is Children's Online Privacy Protection Act.

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