

Web Standardization

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Introduction

The web has become a natural part of our everyday life. In perhaps no other area is the value of standards more evident. The Internet as we know it would not have existed without standards. Such features as global interoperability and connectivity are the result of important standards such as TCP/IP, HTML and XML. The question is if future development will be determined by markets or politics?

Web standards come in many different forms, all of which can be related to different technological aspects such as device communication, common linguistic display or web content. These different standards can be ordered into a certain hierarchy based on their varying degrees of sophistication. This does not mean however, that the quality of a standard gets higher further up in the hierarchy; it rather reflects that there are different layers of technology, each with its own need of certain standards. In fact, the most basic standards have the widest deployment and standards of higher sophistication simply build upon those standards from lower layers of technology.

Unlike more mature industries, where formal standard setting bodies play a dominant role, this is the world of private and informal fora and consortia. Web standardization proves that informal and market-based standardization can be both dynamic and effective.

The landscape of Standard Developing Organizations (SDOs) in Web standards is rather different from other fields, largely because of the global nature of the technology. Many actors occupy the scene of Web standardization although the width of focus varies between organizations.

The dominant actor is commonly regarded to be the World Wide Web Consortium (W3C) whose standards, used by Netscape, Microsoft, Google etc, have largely contributed to the exponential growth of the Web. OASIS, creator of the XML standards, with members such as IBM and Microsoft is another influential organization. The Internet Engineering Task Force (IETF) is not as much of a formal organization as an open community providing a forum where new standards can be publicly developed. Still there is no argument that despite its informal structure, the IETF is has been fundamental in developing the current structure of the Internet.

The field of Web standards is complex and although cooperation between organizations may be close, very few standards are interconnected between SDOs. Competition is fierce in some areas of web standardization but almost exclusively horizontal, e.g. within the same layer of technological sophistication. A wide scope of technologies each demand specific standards and competition drives innovation. At a lower (more basic) level however, competing standards may pose a significant risk to decrease interoperability throughout the entire hierarchy.

Several factors suggest that the structure of dominant SDOs in web standardization might change in the near future. One such factor is innovation. As new markets emerge and existing ones evolve, many organizations strive towards becoming dominant actors within their specific area of technology.

The landscape of web standardization

The Web standards scene is dominated by W3C at the centre of web standardization. W3C both uses input from and delivers standards to other SDOs. Another important role is played by the International Organization for Standardization (ISO). Since ISO is the international SDO with the broadest impact and global acceptance, approval by ISO is important for facilitating market uptake. ISO does not, however, do much development of their own concerning web standards, rather they review the work of others and decide to either approve or disapprove a standard as an international standard. Several of the standards which have served as the Internet's backbone for several decades were developed by the Internet Engineering Task Force (IETF); another central organization on the Web standards scene.

The hierarchic system of web standards development is evident from the standardization map (shown in Figure 1 below). Input is almost always one-way, although produced with participation from other SDOs. Development of Web standards is relatively balanced between international SDOs and vendor led consortia. Most of the development of Web standards is however made in collaborative consortia.

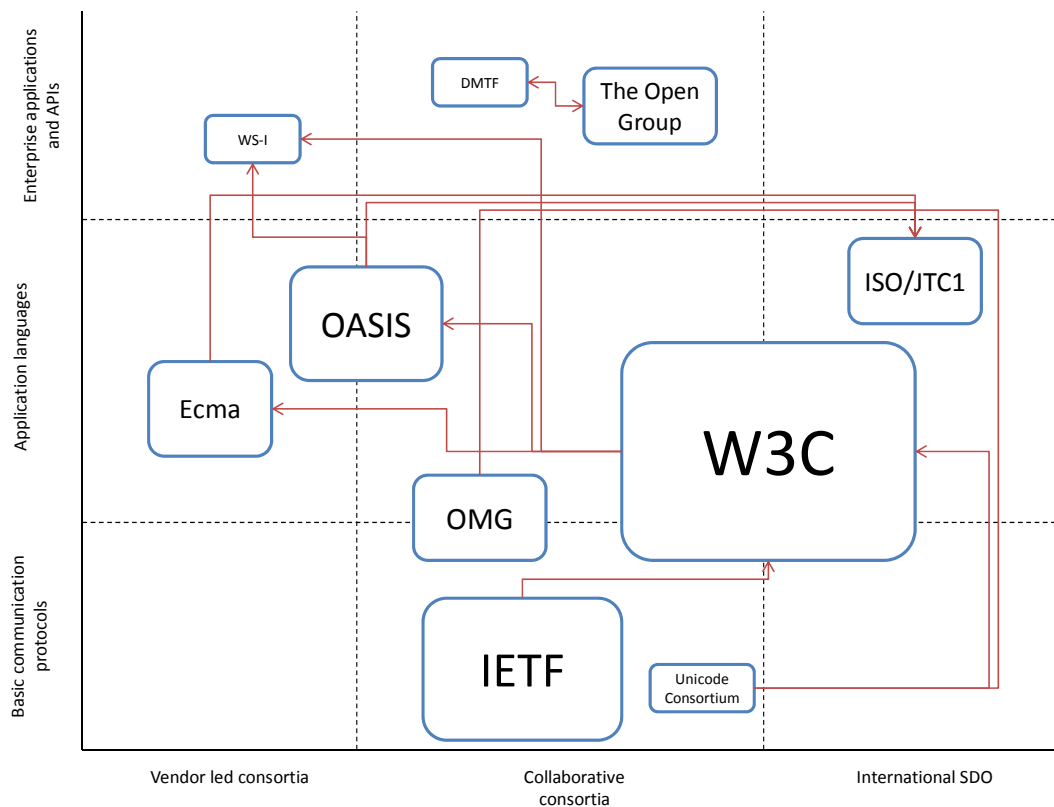


Figure 1. Standardization map over SDOs and Consortia

Case studies

Ecma International

Ecma International (Ecma) is a not-for-profit standards development organization which was founded in 1961 under the name of European Computer Manufacturers Association. In 1994 the name was changed to reflect the international focus of the organization. The ambition of the organization is to, in cooperation with other organizations, develop open standards and technical reports for information and communications technology (ICT) and consumer electronics (CE) within a wide range of areas. The purpose of this is to meet industry needs by generating a market situation where competition takes place in the differentiation of products and services rather than on the level of technology itself.

Ecma is organized in a General Assembly and a number of Technical Committees. Membership is open for any organization but requires the approval of at least two thirds of the current members. Five different levels of membership exist. Four of them are for companies and the fifth level is for non-profit organizations. The total number of members in Ecma is 47 companies and 28 not-for-profit organizations. All members have the right to participate and vote in the technical committees, however, only the highest level of membership grants the right to vote in the general assembly.

The development of a standard begins with a proposition which has the support of at least three members. If accepted by a simple majority vote in the appropriate technical committee or by the General Assembly in a case where a new committee needs to be created, a working group is appointed with the task to produce a standard draft. The working group may possibly also include external experts who are not Ecma members. Once completed, the draft is reviewed by the technical committee responsible for the standard draft. Once the committee is satisfied with the draft it is referred to the General Assembly. Another simple majority may be needed for such approval in the committee but such ballots are unusual since a consensus is expected to have been reached. Twice a year ballots are held in the General Assembly to decide whether drafts are to be approved as Ecma standards, and this time approval requires a two thirds majority. Members however has the right to appeal for a draft to be sent to the General Assembly even without approval in the committee, which is worth noting since only the highest level of membership grants the right to vote in the General Assembly.

Ecma is committed to support the standards until they are removed due to a lack of usage. No tests or certifications of products are offered by Ecma since it is considered to be outside the scope of the organization.

Approved standard documents are made publicly available under royalty-free terms by Ecma, with the right to freely use and copy the material. However, working papers and meeting minutes are usually only made available for members even though the technical committees are encouraged to make documentation public to make it possible for outside interest groups to comment on ongoing work.

Issues regarding possible essential member or third party IPR claims related to standards are governed by the Ecma IPR policy, which requires members to disclose any such patent claims known before a ballot is conducted in the General Assembly. For a standard to be approved it is required that such patent holders offer licenses on Reasonable and Non-Discriminatory terms.

Ecma is working intensely to have the Ecma standards quickly adopted by other standard setting organizations such as ISO by so called fast-tracking. In total, Ecma has published over 480 standards and almost 40 percent of these have been adopted by ISO/IEC. One example of such a standard is ISO 9660, which is the compact disc file system for CD-ROM media adopted in 1988. A more recent example is ISO 29500, the Office Open XML standard for electronic documents developed by Microsoft, which was first adopted by Ecma in 2006 and later adopted as a revised version by ISO in 2008. The most important Web standard of the organization is however ECMAscript, which is the base for the JavaScript scripting language.

IETF

The Internet Engineering Task Force (IETF) is an open global community officially founded in 1986 to develop and promote Internet standards. The Internet is a complex global network, the existence of which has been made possible through several international treaties as well as through technical specifications and protocols, largely developed by the IETF, which describe how data is exchanged between all the local networks that together form the Internet.

In 1992 the non-profit organization The Internet Society (ISOC) was formed with the ambition to lead the open development of the Internet. Since that time IETF is a part of the umbrella organization ISOC.

The IETF is significantly different from other standards development organizations. It is a community of individuals rather than a formal organization, something of an open forum. No formal membership exists and anyone can participate in it. All work is conducted by individuals on a voluntary basis. That being said, most members are sponsored or employed by a company or another organization. The technical work of IETF is done within working groups, of which there currently are approximately 115. These are in turn grouped into eight different fields or areas, which are managed by one or several Area Directors. The Area Directors and the chairman of the IETF constitute the Internet Engineering Steering Group (IESG). Appointments for these positions are made on a two-year basis by a nomination committee, the chair of which in turn is appointed by the ISOC. Such appointments are based on the merits of the participants and IETF can be described as a meritocracy.

The development of a standard starts with the development of an Internet-Draft by a working group or an individual. It should further be clarified that a working group within the IETF is by no means such a formal group as there might be in other standards development organizations. A working group can rather be described as the individuals who sign up on a mailing list open to anyone, a forum where suggestions and specifications for an Internet-Draft are discussed. The Internet-Draft is published publicly for review and comments. Once revised based on received comments, the Internet-Draft is taken through the Area Director to the IESG. The IESG then conducts a final review of the draft, including a Last-Call for comments from the public, before the draft is published as a standard. Publishing is done by inserting the standard in the document series RFC, Request for Comments, which has existed since 1969. However, many different types of specifications are published in the RFC-series, and there are three different levels of IETF standards.

While there is an ambition to reach consensus in the development of a new standard there is no formal voting as in most other standards development organizations. As a result, it is very possible for the IESG to approve a standard for which there is no consensus in the IETF. The approval of a standard in IETF is solely based on technical merit, not whether companies support it or not. On the

other hand, IETF is also an organization where appeals can be made not only based on the procedure of a decision, but also on technical specifications. Such appeals are first made to the IESG and if necessary escalated to the Internet Architecture Board, another organization within ISOC which has existed since 1979 and is tasked with defining the overall structure of the Internet and overseeing the IETF.

IETF is committed to support their standards until they are removed from the public domain. Removal is done by the IESG which, after a review including a Last-Call, change the status of the document in the RFC to historical. Any revision of a standard is done through the same process as the development of a new standard. As can be expected given the structure of the organization, IETF does not conduct any certification or validation of implementations based on IETF standards. However, Applicability Statements are published to provide users with information on how a standard is intended to be applied. Additionally, for a standard to be published with either of the two highest status levels, at least two independent and interoperable implementations have to exist.

In line with the philosophy of the IETF about open access and that anyone should be able to contribute to the development of a standard all documents are made publicly available, including for example preliminary work, meeting minutes and the material on the mailing lists. The intent of the IETF is to contribute with positive value for the Internet community. All participants have to grant the IETF and ISOC the right to publish all contributions under royalty-free terms.

To gain wide acceptance of the developed standards, the IETF has preferred technologies which are not subject to third party IPR. But with the strong technological focus within the organization it is also possible for the IETF to publish standards which require patented technologies if they are considered superior, even in cases where such technologies have not been made available on licenses under RAND terms. It sometimes occurs that patent holders freely approve of their technology being used in implementations of IETF standards. Since a large part of the world's foremost network experts participate in the IETF, such a decision generates substantial goodwill.

Anyone participating in the development of a standard is requested to disclose IPR that may apply but IETF clearly state in each standard document that the IETF accept no responsibility in the IPR area. There is, however, one exception from this general IPR policy. In areas where essential security technology is required for implementation of the standard, IETF demands that at least one such security solution is available under royalty-free terms, otherwise the standard cannot be approved.

Despite the informal structure of the IETF it is a standards developing organization which is fundamental for the structure of the Internet and hence of great importance. IETF also cooperates with various other organizations such as ISO, IEC and ITU, where cross references to standards from the other organizations is done. Likewise, the IETF continually exchanges information with organizations such as W3C and OASIS, since IETF standards form a foundation for the standards developed by these groups.

OASIS

Organization for the Advancement of Structured Information Standards (OASIS) was formed in 1993 under the name of SGML Open to function as a trade organization of vendors for promoting the Standard Generalized Markup Language.

The organization as well as its area of activities has grown considerably and the name change in 1998 reflected the expanded and changed focus, primarily to XML (Extensible Markup Language). The activities have also shifted from promotion to development of technical specifications and open standards for web services. Today, OASIS is a not-for-profit consortium with more than 5 000 participants from over 600 organizations, setting standards within a range of areas such as security, e-business and other application-specific markets.

The membership structure of OASIS builds upon the notion that anyone who is affected by open standards shall have the opportunity to participate in the development of them. Three different levels of membership status exist, but the status of a member mainly affects the level of recognition given to the member, for example by representation in fairs and press releases. Individual and associate-level memberships are also available, but do not grant the right to vote on the approval of a standard or the election of the Board. These membership levels exist to allow the participation of self-employed consultants or unaffiliated researchers in the development process. The OASIS Board of Directors and the Technical Advisory Board are both elected in a democratic process, with the members serving as individuals on two-year terms.

The development of standards is conducted in technical committees, which can be formed by a group of members and in which every member is entitled to participate. Within a committee, a simple majority vote is needed for the advancement of a draft. However, the advancement of a Committee Draft to a Committee Specification requires public review. Once the review period has expired the committee may propose the further advancement of a specification to an OASIS Standard. This is approved in a ballot with all eligible OASIS members. If more than 25 percent of the votes are negative or if less than 15 percent of the member base provides a positive vote the vote is deemed to have failed. The result of all ballots, with the vote of each member specified, is published on the OASIS web page. Once a submission has passed members cannot appeal based on technical specifications. However, appeals concerning the procedures in a technical committee can be submitted to a committee administrator, and the Board of Directors may in turn remedy complaints about the actions of an administrator.

A technical committee may continue to develop an existing standard after it has been passed as an OASIS Standard, something which usually is done. An overview of the standards reveals that within a few years a new version of a standard is typically approved. Considering the quick technological advancements in the industries for which OASIS produces standards this is not surprising. However, OASIS does not have any governance over standards once they are approved, regarding for example support of the standard, in contrast to many other standards development organizations. OASIS does not offer any validation or certification services apart from various case studies of implementations published online and the demonstration at fairs and conferences of interoperability of implementations of OASIS standards.

All documentation, not only the standard specifications, from the technical committees and steering groups is published online. Anyone participating in a technical committee transfers the intellectual property rights of their written contributions to OASIS under irrevocable, non-exclusive, royalty-free and worldwide terms. OASIS in turn grants anyone permission to freely copy and distribute all such documents as long as OASIS' copyright notice is included.

Everyone participating in the work of a technical committee is requested to disclose to OASIS in writing all patents or patent applications owned or claimed by them. Each committee, in its charter, has to pick one of three IPR models which it will operate under and which will govern how licensing terms must be offered for disclosed patents. The first model is worldwide, non-exclusive licenses on Reasonable and Non-Discriminatory (RAND) terms. The second model is royalty-free RAND terms, and the third model is royalty-free on Limited Terms. In June 2009 OASIS announced a fourth IPR model, the so called "Non-Assertion" IPR model. Under this model the members will agree to a covenant not to assert patent claims, removing the need to seek licensing for implementers and the need to do patent inventory searches for participants and contributors. This new model will be available for newly created technical committees after August 3 2009.

OASIS produces more standards for Web services than any other organization and among its members are several of the world's most influential ICT corporations. The highest level of members includes for example IBM, Microsoft, Oracle and Sun, and the board contains members from such influential companies as Fujitsu, Hitachi, Nokia, Nortel and SAP. OASIS also actively cooperates with several other standards development organizations. For example, OASIS produced five specifications for Electronic Business using Extensible Markup Language (ebXML) in cooperation with the United Nations, which were later adopted as the ISO 15 000 standard. The ebXML is a family of standards based upon XML which enables global electronic business.

Another important standard developed by OASIS, and still under further development, is the OpenDocument Format (ODF), a standard for electronic documents which builds upon XML, first approved by OASIS in 2005 and later adopted as an ISO standard. The standard is based on work done by OpenOffice.org, which in turn is based upon development by Sun Microsystems. This standard is competing with the Office Open XML standard from Ecma International, which is based on a format developed by Microsoft for their Microsoft Office 2007 suite. However, in 2008 Microsoft joined the OASIS technical committee for further development of the ODF standard and Microsoft will offer full support of the ODF standard in service pack 2 for Microsoft Office 2007.

W3C

The World Wide Web Consortium (W3C) is an international consortium founded in 1994, which develops open standards (called "Recommendations") and guidelines to create interoperability on the Web. The impact of W3C is evident in the Web 2.0 phenomenon of blogs and social networking applications, where W3C standards like HTML/XML, CSS and DOM are directly related to the emergence of these new application areas on the Web.

The ambition of W3C is to prevent fragmentation of the Web and ensure continued growth by promoting standards for languages and protocols to be used in applications. The consortium is jointly hosted by MIT/CSAIL in the United States, ERCIM in France and Keio University in Japan and in total the consortium has over 400 members from over 40 countries.

Membership in W3C is open for any organization. W3C is not structured for individuals but they may join as affiliate members. However, individual non-members, such as experts from the academic world, are also invited to contribute in the development of a standard. Various forums and workshops are also open to non-members and comments from non-members are encouraged in the public review of proposed standards. W3C is organized by a management team consisting of roughly

60 persons employed by W3C's hosts and by a board whose members are elected by a committee in which every member organization is represented.

The development of a standard is done in a working group, where all members are free to participate. In total there are 72 such active working groups at the moment and they are organized into 23 different areas. Once a working group reaches consensus, it publishes a proposition as a draft for public review. The definition of consensus within a group is set by each group individually, but the general view of consensus is when no formal objection to a decision exists. Once the public review has been completed and the draft has been revised accordingly, it can be advanced to a recommendation. However, many of the developed drafts are never advanced beyond a draft status due to patents not being available on Royalty Free terms.

There are three different levels of recommendations: Candidate-, Proposed- and W3C Recommendation. Each step of progress in status requires a review where a set of demands have to be met. The advancement from a draft to a Candidate Recommendation for example requires a statement declaring how the standard relates to all other relevant standards and ongoing developments in other standards development organizations. The advancement to a Proposed Recommendation requires that at least two independent and interoperable implementations should have been successful. In order for to reach the status W3C Recommendation, the technology is required to be considered ready for worldwide implementation. If any member strongly disagrees with a decision, that member may appeal to the chair of the working group at the earlier stages and to an Advisory Committee at the final stages. It should also be noted that during the public review of a draft, non-members are free to comment on it and a working group is required to formally document how it has considered each comment that has been made regarding a draft.

W3C commits to support recommendations until removal, something which is done under a defined process. Revisions of recommendations may be done through a short process if the changes are minor, but if new features are included the revision of a recommendation follows the same process as the development of a new one. For some of the recommendations, various tests, guidelines and validation tools are made publicly available online. These additional resources are pro bono in nature and are voluntarily created by decision of either the working group or the community behind it.

Each working group is free to decide its own confidentiality level but is expected to produce at least one public version of its technical report every three months. Conversely, the advancement of a draft to a recommendation requires that a large part of the working material is made public.

Specifically, the advancement of a draft to a recommendation requires that any essential third party technologies are made available under a royalty-free license. This patent policy enables open source implementation of W3C Recommendations. Published material is regulated by the W3C Document License, which grants anyone the royalty-free right to copy and distribute it.

In total W3C has published over 110 recommendations and the W3C has been a very important factor throughout the development of the Web. The W3C also cooperate closely with a number of other standards development organizations, for example IETF, Unicode Consortium and ISO/IEC JTC1. Compared to IETF, W3C's area concerns a higher level of technology hierarchy. The IETF develops standards for the structure of the Internet, and the Web is one application of the Internet.

The first standard for HTML, the language used in the construction of Web pages, was published by the IETF, but originated from Tim Berners-Lee, W3C's current Director. After W3C was formed the development of HTML was moved to W3C, and today there are still three working groups actively working to improve the HTML standard. Another very important standard for languages is Extensible Markup Language (XML), which was developed by W3C and reached the status of W3C Recommendation in 1998. The use of these and other W3C standards by actors such as Netscape, Microsoft and Google have significantly contributed to the exponential growth of the Web on a global scale.

Discussion

The competition in Web standards is largely horizontal, while vertically there is mostly cooperation. Competition is also generally somewhat greater among the higher layers of technology. Because of the industry's structure, competition in the lower layers of technology could threaten interoperability and most likely cause more harm than good. Meanwhile competing standards in the higher layers result in smaller loss, also it contains many specific areas each with its own need for specific standards. It should also be noted that standardization has largely started at the bottom of the technology scale and worked its way up the hierarchy. Therefore it is not surprising that many vie for the central standard in a specific technology area since the market has yet to decide which standards will prevail and which will succumb. This is evident from the large amount of consortia dealing with specific issues in the higher layers of technology or within specific markets, commonly with aspects relating to e-Business¹.

The four organizations discussed in further detail in this report all differ from each other. Ecma is a pure vendor led organization, where large international corporations are given a chance to develop new standards in a timely fashion for the market and submitting them to ISO in a standardized process. OASIS, while having a similar scope in the development of standards as Ecma, is more collaborative by including a larger base of stakeholders in the development process. OASIS is also more open with regard to the development process than Ecma. Both Ecma and OASIS standards have a large uptake which implies that differences in the nature of organizations do not necessarily determine the level of market acceptance a standard will reach.

W3C is the central hub of Web standards development. No other organization can measure up to the impact of W3C on the Web standards arena. W3C also incorporates a large range of memberships, both geographically and representing different stakeholder perspectives. IETF is quite unique with a very informal organization, consisting of only individuals and with neither a formal voting processes nor membership. There is however no arguing that the IETF have been responsible for producing several standards which are the backbone of today's Internet, even if it has not produced any severely influential standards in the last few years. Since the IETF is active in such a rudimentary level of Internet technology development, it might need to show progress in order to avoid being challenged by new organizations for its leading position.

Combined, these four SDOs have a great impact on Web standardization. Ecma is however different from the other three organizations as its focus not only lies on Web standards, and has won its greatest influence with ECMAscript, the language which is the base for JavaScript scripting language. The future influence of Ecma will largely be decided by to what extent they decide to develop Web

¹ See for example the listing of consortia at www.consortiuminfo.org or the [CEN ICT consortia survey](#).

standards in relation to other standards within their focal areas. IETF's future influence might also be at stake depending on whether they are able to put forth new influencing standards in the next few years. OASIS are still gaining influence and will probably be a major factor in developing more advanced Web standards for the years to come. W3C is currently unchallenged as the central organization of Web standards development. If anything might put a dent in W3C's prominence it would be if its founder and Director Tim Berners-Lee was to decide to seek challenges elsewhere. W3C's success is closely entwined with its Director and it is hard to see how W3C could find a worthy replacement to the "Father of the Web" as an ideologist and herald for Web standardization.

While Web standards development has for the most part not been the agenda of any specific country, development with regards to both contributions and agenda setting has been concentrated to the Western nations and their various ICT companies. Some regional initiatives occur, such as the European Interoperability Framework, but these have more to do with implementation and architecture than the standard setting. The next generations of Web users are however coming from the recently developed world in such regions as Eastern Europe, East and Southeast Asia and Latin America. Led by the BRIC countries, these regions are likely to want a greater influence in the largely global organizations of W3C and IETF. This development is recent and will be ongoing for the next decade until the Web standard setting map will begin to resemble that of global internet activity. This might also influence the impact of vendor led consortia. In several of the newly developed countries, governments traditionally have had a larger say in the standard setting practices and might therefore attempt to hinder an explosive creation of vendor led consortia, as these tend to operate with limited, or completely without, governmental influence.

The Web is evolving and its users are seeking new ways to utilize it. With the mobile era of wireless broadband, new standardization will be required to enhance internet capabilities to allow for wireless access through devices to the same extent as traditional computers and servers. This opens up to further cooperation between the domain of wireless networks and that of Web standardization. The activities on the Web have also changed, with personalized features like blogs, social networks and interactive content booming during the first decade of the 21st century. The next step will presumably be the use of information on the Web in a more intelligent fashion, the so called "Semantic Web" or "Web 3.0". This is a new development that will need restructuring and adoption of web pages and servers around the world in order to get the greatest gains from network effects and it will be reliant on further standardization of Web content and communication. In this respect W3C is already well prepared and will have a good ability to champion this new era of Web utilization among citizens, governments and corporations.

Appendix: An overview of Standard Setting Organizations (SSOs) in Web Standards

Although the organizations within the scope of web standardization differ from each other as to the width of their technological focus, some features remain common. For example, the vertical perspective of an organization is generally narrow. In practice, this implies that few organizations are involved with standardization of several layers of technological hierarchy. Rather, the organizations build upon standards developed by other SDOs and in turn provide their standards to other organizations for further refinement and extensions. The following section presents a closer view on some of the more influential organizations in Web standardization.

Distributed Management Task Force (DMTF)

Website: www.dmtf.org

The DMTF is a collaborative standardization effort for the development, validation and promotion of systems for management of IT environments in enterprises and on the Internet. The group has 160 member companies and organizations, and more than 4000 active participants in 43 countries. DMTF standards enable building systems management infrastructure components that are independent of platform and use of technology, allowing for interoperable IT management.

Ecma-International

Website: www.ecma-international.org

Ecma is a vendor led not-for-profit industry association founded in 1961 and develops Information and Communication Technology (ICT) standards. Ecma deals with standardization in a broad area of activities including hardware, software, communications, consumer electronics, etc. Membership is open to companies that produce, market or develop computer or communication systems. Ecma publishes their standards and reports publicly with the aim to facilitate and standardize the use of ICT and consumer electronics. Ecma specializes in fast-tracking standards to ISO.

The Internet Engineering Task Force (IETF)

Website: www.ietf.org

The IETF is an open international community that develops Internet standards. IETF is a self-organized group engaged in the engineering and evolution of Internet technologies. The community is open to any individual but consists mostly of network designers, operators, vendors and researchers. IETF is working to solve operational and technical problems for the Internet, facilitate technological transfers to the wider Internet community, and provide a forum for the exchange of information between its members.

ISO/IEC JTC1 Information Technology Standards

Website: isotc.iso.org

ISO/IEC JTC1 is Joint Technical Committee 1 of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). JTC1 serves as a development forum for worldwide ICT standards and the integration of diverse and complex ICT technologies. JTC1's mission is to develop, maintain, promote and facilitate ICT standards required by global markets for meeting business and user requirements. JTC1 members are national standard bodies and other

organizations participate as “Liaison Members”. Approximately 2100 technical experts work within JTC1.

Object Management Group (OMG)

Website: www.omg.org

OMG is an international, open membership, not-for-profit computer industry consortium with a broad membership base consisting of many leading organizations representing a wide range of interests. OMG develops enterprise integration standards for technologies and a wide range of industries. OMG has produced several specifications which allows for heterogeneous and distributed software development projects and several specifications have been fast-tracked to ISO.

The Open Group

Website: www.opengroup.org

The Open Group operates on a global level and is a not-for-profit, vendor- and technology-neutral consortium to set open standards for computing infrastructure. The members include a range of IT buyers and vendors, as well as government agencies. The services offered to members include strategy, management, research, standards, certification and test development. Based on open standards and global interoperability, the Open Group works to share best practices, establish policies and enable interoperability for business and development. The Open Group is the certifying body for the UNIX trademark.

Organization for the Advancement of Structured Information Standards (OASIS)

Website: www.oasis-open.org

OASIS is a not-for-profit global consortium of vendors and users that handles the development, convergence and adoption of open standards for the global information society. OASIS produces Web services standards as well as standards for security and e-Business. The Cover Pages and XML.org are two of the most important information portals on XML and Web services standards held by OASIS.

Unicode Consortium

Website: unicode.org

The Unicode Consortium is a not-for-profit organization founded to develop, extend and promote use of the Unicode Standard. The Unicode Standard enables people to use computers in any language around the world since they provide a unique number for every character indifferent to platform or program and thereby allows for software internationalization in operating systems, search engines, applications and the Web. Unicode is required by standards such as XML, Java, ECMAScript, etc. Membership is open to anyone and members mainly consist of corporations and organizations in the information processing industry.

World Wide Web Consortium (W3C)

Website: www.w3.org

W3C is an international consortium that develops interoperable technologies and global standards for languages and protocols to be used in Web applications. It serves as an open forum for information and collective understanding about the Web. W3C members (mainly organizations) and a staff of technical experts participate in working groups and publish open standards with the aim to prevent fragmentation of the Web and ensure continued growth of the Internet.

Web Services Interoperability Organization (WS-I)

Website: www.ws-i.org

WS-I is an open industry organization that develops best practices for interoperable Web services based on a select group of Web services standards. Rather than defining standards for Web services, WS-I creates guidelines and tests for interoperability. WS-I consist of members from a variety of companies and SDOs. The work is conducted in working groups which create profiles and other materials to support Web services Best Practices and standards interoperability. WS-I works closely with other organizations developing Web services standards such as OASIS, W3C and other SDOs.