Selected Intellectual Property Issues in Standardization

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Abstract

This paper explores several issues related to intellectual property in the standardization process. Different intellectual property issues dominate during the three major phases in the life cycle of a standard: development, where the content of the standard is created; distribution, where documentation on the standard is shared with the vendor and user community; and implementation, where products and processes based on the standard are brought to market. Many of these issues have implications for policymakers and stakeholders. The implications are considered and the options available to policymakers and stakeholders are enumerated.

I. Introduction

Standards are becoming increasingly important in today's information technology industry. With the exception of Farrell's work (Farrell 1989), much of the research in standards and the standards setting process has focussed on economic issues. In this paper, we consider the intellectual property issues of standards and the standards setting process at all points in the life cycle of a standard. Our discussion may be naive from a legal perspective because we are not lawyers practicing in this area. Nonetheless, we believe that some significant unresolved issues exist at the intersection of intellectual property and the standardization process.

One may view standardization as a process involving three distinct phases.[1] Standardization includes the development of the standard (*i.e.*, the specification, in an unambiguous and public form, of that aspect of the process or product that is to be the same for all implementations), the distribution of the standard to the vendor and user community, and the implementation of the standard (*i.e.*, the development of products that conform to the standard). In each phase, distinct intellectual property issues exist. The changing nature of the information technology standardization process introduces some further intellectual property issues that must be considered.[2]

Traditionally, in the standards specification phase, standards formalized and made public an existing dominant industry practice or technology. The ownership of protected intellectual property related to the standard was clear, most often in terms of a patent. When a standard is to be a US national standard, in accord with the Procedures for the Development and Coordination of American National Standards, the owners of any intellectual property rights agree to license the product at a fair price and in a non-discriminatory way (ANSI, 1987, p. 28). In contrast to this historical tradition of standards sanctioning an existing well-defined product, standards today may precede products (Cargill 1989, Weiss 1991a, Bonino and Spring 1991).[3] Technologies can be developed in committee during the development of the standard, leaving the disposition of intellectual property rights uncertain.

In the development of a standard, significant issues revolve around the ownership of intellectual property. The relevant intellectual properties are often covered by patents and copyrights on the contributions to the committee. While the software patent tradition is still evolving, it can apply to software-based contributions. For hardware-based contributions, the patent protection is much more clearly applicable. Similarly, copyright law can also apply if the contributed software has been protected by its owners. This protection would only apply to the actual code, not the underlying algorithm, in accordance with traditional interpretations of the law (OTA92b). Modifications to contributed software could also be protected, as they would be considered derivative

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1 While the phases are conceptually distinct, in practice, the phases overlap. Most commonly, the third phase may occur concurrently with the first two phases.

2 There is some evidence that the standardization process is changing across industries in the same way it is in the information technology industry, although the change is most dramatic in the high tech and information technology industries.

3 Standards that are developed and disseminated before compliant products have achieved a dominant market penetration are commonly referred to as anticipatory standards.

works. Trade secret law does not apply because when a technology is brought into the committee, it is no longer a secret, but rather a matter of public record. Since some intellectual properties are developed in the public, voluntary committees, questions are raised about who owns the ideas.

In the dissemination phase of standardization, the issues pertain to the copyright of standards documents. Copyright is almost always owned by the standards development organization (SDO) sanctioning the activity. For a number of SDOs, revenues from the sale of standards have become significant. As technologies converge, diverse SDOs must harmonize their standards with other SDOs. In many cases virtually the same intellectual property is sold under multiple different names. This competition, and the resulting revenue implications, has already caused some contention to arise between SDOs (OTA 1992a).

Finally, there are intellectual property issues in the implementation phase of standards as vendors build products that are based upon the standard. With the emergence of anticipatory standards and complex highly interdependent standards, the development of tests to assure product compliance becomes more important. In recognition of the fact that products developed in accord with standards sometimes fail to interoperate, there has been increasing pressure to develop unambiguous languages for the specification of standards that will allow for an automated development of test suites. When test suites are developed by an organization other than the SDO, one may ask whether the tests are derivative works of the standard and therefore protected under the copyright statutes.[4]

A. Forms of Intellectual Property Protection

Historically, the state has protected intellectual property (IP) because this protection (presumably) meets social objectives. That is, the IP protections should be designed such that the specific social goals are advanced by that protection. (OTA 1986, Ch. 3) In this paper, we assume that IP protections are beneficial and meet social goals. This assumption should be examined more carefully in future analyses.

Four basic mechanisms exist for the protection of intellectual property: patents, copyrights, trademarks, and trade secrets.[5] Of these, trademarks and trade secrets are generally not relevant to this discussion. It is generally agreed that the purpose for intellectual property protection (via patents and copyrights) is to motivate individuals and firms to produce such property. Intellectual property laws provide a monopoly on an idea or an expression that would not be possible by other means. Were it not for these forms of protection, an idea, once conceived, could not be placed into the public domain without the total loss of benefits to the developer of the idea. Under these circumstances, individuals would lack an incentive to produce more ideas (or at least to place them into the public domain). In terms of this incentive one may argue that any intellectual properties associated with compatibility standards, which must by definition be public, are absolutely dependent on the availability of intellectual property protections.

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4 Indeed, one might ask whether every use of the test suite should involve a royalty payment similar to that paid by artists for the right to perform a given piece of music.

5 This discussion on forms of intellectual property protection draws from the recent OTA report *Finding a Balance: Computer Software, Intellectual Property, and the Challenge of Technological Change* (OTA 1992b).

Patents are issued to

> *"[w]hoever invents or discovers any new and useful process, manufacture, or composition of matter, or any new and useful improvement thereof . . . (35 USC 101)*

In contrast, copyrights are issued for:

> *"works of authorship . . . fixed in any tangible medium of expression, now known or later developed, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device (17 USC 102(a)).*

Loosely, one could state that patents cover the works of inventors and copyrights cover the works of authors. In the information technology world, however, the distinction between these two is fuzzy. This area has been the subject of several recent court decisions. Historically, there has been a reluctance to grant patents on algorithms, although this is changing in the US (OTA 1992b).

As many information technology standards are international in nature, international agreements on patents and copyrights are of interest. The bilateral, regional, and international reciprocity agreements generally provide, with a couple notable exceptions, reasonable copyright protection. The Berne Convention for the Protection of Literary and Artistic Works of 1886 and the Universal Copyright Convention of 1952 provide for certain minimum protections using the national treatment rule, *i.e.*, the work of a foreign author is protected in a given country in the same way the work of a native author would be protected. More than 70 nations are signatories of the two conventions (Nordheim *et.al.* 1990, Stewart 1989). While questions about protection of copyright remain, they are essentially moot within the set of nations concerned with information technology standards and technology, as most of these countries are signatories to one or both of the multilateral conventions discussed above.

II. Intellectual Property Issues in the Process of Standardization

Numerous researchers have begun to study the process of standardization. In particular, Weiss and Cargill(1992), Lehr(1992), Bonino and Spring(1991), Weiss(1991), and Cargill(1989) have examined some of the ways in which the process of standardization is changing in the information technology arena. The issues here involve the globalization of standards, the emergence of consortia, the anticipatory nature of selected standards, the complexity and interdependence of standards, etc. In the next three sections, intellectual property issues pertaining to the changing nature of information technology standards and standardization are discussed in terms of the major phases of standardization--development, dissemination, and implementation. Three significant changes in the standardization process serve to focus the intellectual property issues explored:

1. In the development of anticipatory standards, intellectual properties are more likely to be created in the standards committee.
2. Regarding the dissemination of standards, the publication revenues from standards have become important contributors to the financial well-being of some standards development organizations.
3. Implementing standards is a matter of assuring product conformance. Increasingly, conformance tests and other conformance mechanisms are tightly coupled to the standards, raising the issue of derivative works.

There are other issues, related to but outside the framework of intellectual properties in the process of standardization, that are outside the scope of this paper. For example, this paper will discuss the notion of standards based conformance tests as derivative works under intellectual property laws. It will not discuss whether the developers of standards have liability for tests derived from their standards.

A. The Development of Standards

Historically the development of a standard has involved vendors bringing technology to the standards committee so that it can be considered for inclusion in the standard. The vendors compete with each other because the vendor whose approach or technology serves as a basis for the standard may have a competitive advantage in the subsequent marketplace for standardized products. In this case, the disposition of intellectual property is fairly clear. The technology is owned by the vendor; they developed it and brought it into the committee. If it is included in the standard, the vendor has the right to license the technology, and, under ANSI rules (ANSI, 1987, p. 28),[6] the obligation to do so without discrimination and "at reasonable cost". Note that

6 In general, license fees are not beneficial to the standardization process if the cost is passed on to the consumers of the product. In this case, higher product prices may limit the adoption of the standard by consumers as well as producers.

these rules apply specifically to ANSI accredited US standards bodies. Other SDOs, such as non-accredited committees and non-US committees, may have different rules. In the case of non-US committees, the owners of the IP, granted through ANSI, would be protected under existing international agreements.

While the process of developing standards based on existing stable products assures stable standards, a different process is required when product life cycles are shorter than the standards development life cycle. The standardization process is time consuming, particularly if the number of participants is high and they have divergent preferences (Weiss 1991b). When a market exhibits rapid technological growth, as the information technology market has, the time required to develop a standard may be longer than the product life cycle. To cope with this, standards bodies have begun to act in anticipation of the technology, developing standards before products are produced. These are known as anticipatory standards (Cargill 1988). In fact, Bonino and Spring (1991) argue that anticipatory standards act as mechanisms for collective market planning; *i.e.*, they are an embodiment of a private industrial policy.

With anticipatory standards, the model of standards development is quite different. In order for anticipatory standards to be an effective method for standards development, the industry requires something of a unified vision of the future.[7] In other words, the system environments of the future that are likely to be dominant have to be articulated, and the necessary standards infrastructure understood and defined. This imposes a substantial strategic planning requirement on the SDOs and the industry as a whole. These requirements can be articulated through organizations such as ANSI's Strategic Planning Committee. In contrast to anticipatory standards, consortia have also emerged that attempt to achieve the same goal by speeding up the standards development process (Weiss and Cargill, 1992).

New ideas are being developed in, and as part of, the standardization process, however it is achieved. While organizations may submit technologies to the committee, as before, for inclusion into the standard, substantial portions of the technology may be either motivated by the committee or actually developed in the committee. The intra-committee development may be the result of a compromise that was necessary for the standards development process to proceed. If the compromise was based on the adoption of a single technology, the intellectual property issues are similar to the traditional case. If the compromise was based on the merger of two proprietary technologies, then the ownership of the resulting technology is less clear. Finally, if the compromise resulted in the development of a third alternative technology not encompassing either of the original technologies, then it is completely unclear who owns the rights to the technology.

Similar problems are faced by consortia developing standards, although it is easier to dispose of the intellectual property, because the consortia are essentially private organizations working to further the benefit of its members. The Open Software Foundation (OSF) has written its intellectual property arrangement into its membership agreement.

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7 There is an ongoing debate about the value of anticipatory standards. Since they have to be developed for a future environment, they have to predict markets in the future. If the future is incorrectly anticipated, the standards may be of little or no value. The cost of suites of standards such as ISDN and OSI is high. Some would argue that the cost is not justified by the need to redefine these standards prior to using them.

In anticipatory standardization, where the technology developed is a merger of two distinct, proprietary technologies, one could easily argue for shared ownership. That is, the two firms who owned the technology would share equally in revenues obtained from licensing. A joint holding company could be established to administer the licensing arrangements, but this is not entirely satisfactory. Is it not the case that the merger of the two technologies, in themselves, is intellectual property that might warrant protection? If so, who owns it? Ideally, the person with the idea should own it, but how is that ownership established in a setting where the merger was developed in a group environment? Should the product (*i.e.*, the merged technologies) be in the public domain, because the SDO is sanctioned as a national standards development organization, because the existence of the standard could be deemed to be in the public interest, and because, once developed, standards are a public good?[8] Further, it will often be the case that the intellectual property will fall under the patent domain. Who should, will, or can assume the sometime significant cost of filing (especially for patents)? What recourse, if any, do SDOs have in the minutes of meetings as indicators of the origin of ideas? How does the membership of the SDO and the secretariat affect these issues? For example, the IEEE standards effort is in essence the effort of independent professionals -- who may or may not be supported by their employer. X3 on the other hand is organizationally composed and the secretariat is supported by corporate members.

Consortia introduce yet more dramatic examples of committee development of intellectual property. Here, no member firm can legitimately claim ownership of the technology, because it was developed collectively. Many of the questions articulated above also apply in this case.[9]

B. Dissemination of Standards

The SDO almost always holds the copyrights on standards documents and is in a position to determine how the documents will be disseminated as well as how any revenues that accrue from the sale of the documents will be allocated. While the dissemination of standards is generally managed directly by the standards development organization, this responsibility may be delegated to a publisher or other party. Thus, the SDO normally controls dissemination of the standard by directly or indirectly publishing and selling the standard to interested parties. In many cases the SDO derives significant revenue from the sale of standards and carefully guards its copyright so as to maximize revenues. Other SDOs subcontract what may be a break-even activity to an organization that can do the publishing on a more cost-effective basis. One of the more uncommon publishing policies is that of the Internet Engineering Task Force (IETF). The IETF is responsible for developing and maintaining the standards used on the Research Internet, such as TCP/IP, SMTP, *etc.* The IETF makes their standards, called RFC's, available electronically, and waives all publishing or use fees. A common argument in the telecommunications research community is that this policy may have helped TCP/IP in attaining a significant share of

8 The public good argument for standards is due to Kindleberger (1981).

9 Additional dimensions also exist. For example, if it is considered in the public domain, should it be considered "national intellectual property" in the sense that it belongs to the country that developed it? Can a country have a proprietary interest in a technology?

the market. The argument is that since university researchers could obtain the standards at no (direct) cost in electronic form they elected to choose these standards over CCITT or ISO standards.[10] In fact, this has become a very important issue of late, as articulated in the OTA report on standards (OTA 1992a).

We contend that information technology standards, even more than other technical compatibility standards, need to be more widely disseminated. This is because users as well as manufacturers must often have significant knowledge about the standards on which their systems are based if they are to use them efficiently and effectively. For example, users did not really have to understand the details of paper and typewriters in the past, whereas they do have to understand electronic document processing standards such as SGML, ODA, and EDI.[11] More concretely, IBM doesn't need to know about airplane standards, even though they use them frequently when IBM employees fly or when equipment is shipped via air mail, whereas Boeing needs to know about information technology standards to operate efficiently and effectively as a manufacturer of aircraft. Thus, the market for information technology standards is relatively large and this has significant financial implications for both producers and consumers of standards documents.

Because of this market expansion, the revenues generated by standards documents have become more significant to the SDOs, to the point where they are a significant fraction of the overall revenues of the SDO. With this much revenue at stake, the SDOs have become very contentious, as documented in the OTA report (OTA 1992b). Indeed, there is some suggestion that the pricing of standards by some SDOs may be negatively effecting their adoption. Interestingly, originators of standards may choose to shop among SDOs, just as authors shop among publishers, until they find the SDO that will provide for the widest possible dissemination of their ideas.[12]

C. Implementation of Standards

Once the standards development is complete and the document has been published, it remains for vendors to develop products. David's taxonomy of standards would characterize most information technology standards as technical compatibility standards (David, 1987). Compatibility, or conformance to the standard, may be measured either of two basic ways:

1. The conforming product must interoperate with other products that are known to conform. When standards are relatively simple and based on existing products, it is possible

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10 There may actually be non-trivial indirect costs associated with accessing these standards, such as access to computer equipment and attachment to the network.

11 This may simply be a temporary anomaly caused by the relatively recent emergence of these standards.

12 Vendors may also select their SDO based on the likelihood that their preferred technology will be adopted (Lehr 1991).

to define conformance in terms of actual interoperation. In fact, with hardware standards, semiconductor manufacturers built Integrated Circuits that embodied the standard. As long as these IC's were compatible, it was likely that the products would also be compatible.

2. The conforming product must pass some conformance test(s). As standards become more complex, more option based and are developed in advance of products, the conforming products must pass a series of tests to assure compatibility.

Historically, vendors have developed conformance tests for standards that have been applied internally. As the costs of incompatible systems have grown, major users and SDOs have begun to call for third party certification of conformance. The conformance tests are designed to determine whether a particular product conforms to the standard. Thus, conformance tests are used by vendors and users as a predictor of interoperability, which is the user's primary concern.[13] If a product passes the conformance test, it is believed to be likely to interoperate with other products that also passed the conformance test.[14]

There has been increasing pressure to develop standards that are absolutely unambiguous. In the end, if a standard is correctly developed, the development of the conformance test should be mechanical. To achieve this kind of precision, a protocol is formally specified in a standard language such as LOTOS or Estelle, and conformance tests are written in Tree Tabular Combined Notation (TTCN). TTCN acts as a high level language to describe the details of the testing procedures. The actual test sequences and low level software that are implemented in the testers are often generated automatically using a TTCN compiler (Linn 1989).

In this case, the development of conformance tests are dependent on the standard. Since conformance tests are simply a more formal expression of the underlying standard, are conformance tests to be considered derivative works of the standard? Current copyright law would suggest that the test sequences are derivative works of the TTCN notation, just as machine code is a derivative work of the original higher level language code (OTA 1992b). Are manufacturers of test equipment liable for royalty payments to SDOs for the use of the test sequences based on TTCN-based conformance tests? If so, is some royalty due the SDO that owns the copyright to the standard? Currently, this is not a problem, because the conformance testing industry is just emerging, so the magnitude of money that is involved is relatively small. If conformance testing becomes more lucrative, however, and if the tests are to be considered derivative works, it is likely that a royalty arrangement will have to be worked out between the test developer and the SDO.

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13 This has lead to the observation by several vendors that they build products to the conformance test, not to the standard.

14 This is by no means a *guarantee* of interoperation, however (Castro 1990). Because of the complexity of the standards it is possible that two products that pass the same conformance tests do not interoperate in a satisfactory manner.

III. Discussion

Of the possible intellectual property issues identified in the three phases of the standards development life cycle the most significant new issues would seem to be:

1. the development of intellectual properties in the standards committee and;
2. the definition of conformance tests as derivative works of the standards upon which they are based.

There are at least five communities of interest that might be considered in the development of public policy: global, national, enterprise or consortial, corporate, and individual. That is, we might propose public policy to protect the rights of the individual committee member, an SDO, or the global community. At the current time, much is being said about the development of public policy to protect the national interests in standards.[15] In the discussion which follows, no effort is made to develop or discuss public policy with respect to all of the communities of interest. In the case of committee-developed intellectual property, the discussion is focused on public policy as it relates to the rights of individuals and organizations that support those individuals. In the case of test suites as derivative works of standards, we focus on the issues from the point of view of the society, both national and international, versus the SDO.

In the development of any public policy, it is necessary to balance the needs of society against the rights of the members. Stiglitz (1991) has argued that intellectual property protection is incomplete and imperfect, but that this imperfection is not always bad for society. In fact, he argues that:

> *. . . intellectual property protection is important, but, almost of necessity, imperfect. It is harder and therefore more costly to define than conventional property, and by the same token, it is costlier to enforce intellectual property rights. In some cases, the inventor gets more than his marginal contribution, in other cases, less. Intellectual property protection strengthens dynamic efficiency and competition, but often at the expense of static efficiency and competition. If overly strong, it can actually hinder both dynamic and static efficiency and competition. Public policy towards intellectual property must take into account this perspective. There is no simple prescription; as in other areas of what economists refer to "the economics of second best", appropriate policy needs to take into account the facts and circumstances pertinent to different situations.*

Thus, we are reminded that the intellectual property rights related to standards must be considered in a social context.

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15 See, for example, the recent OTA report *Global Standards: Building Blocks for the Future* (OTA 1992a).

A. A Framework for Analysis: The Goal of Standardization

Standards may be developed to provide basic measures, assure quality, or provide for compatibility (David 1987). Information technology standards are predominantly developed to allow for technical compatibility. A compatibility standard must be widely implemented to be successful. Although Katz and Shapiro (1986) point out that this "lock-in" is not always optimal, widespread adoption remains the most important indicator of the success of a compatibility standard.

No definitive list of factors that contribute to the adoption of a compatibility standard has been identified in the literature. Sirbu and Stewart (1986) identified the locus of decisionmaking as important predictors for which product type (*i.e.*, modems) is likely to be subject to standardization, this does not extend to a standard-by-standard comparison within a product type. Weiss and Sirbu (1990) have considered attributes that may indicate technical superiority of a technology in a standards committee, but that is only one dimension and is at too low a level to be useful here. Thus, we are left to propose a set of factors based on informal observation of the industry and general familiarity with the literature. We suggest that the goal of adoption is generally achieved when the standard is:[16]

Accessible Standards must be accessible to potential users and vendors. A standard that is not accessible is not likely to be widely implemented. As we stated earlier, a theme in the research community hypothesizes that the success of the TCP/IP protocols is largely due to the fact that the standards were very accessible to the academic community, who developed systems (*eg.*, BSD Unix) and applications (*eg.*, electronic mail, distributed file systems) based on that suite rather than the OSI protocols that were emerging at that time.

Timely Historically, it has been felt that standardization too early in the development process stifled the emergence of the optimal product. More recently, in the information technology arena, the late emergence of standards has resulted in lack of compatibility.[17]

Appropriate As with any product, the appropriateness of the technology to the user's needs and its manufacturability at reasonable cost is important. If a standard embodies technology that is too advanced, then compatible products will be either too costly or late to market. This was the case with the early V.32 modems. These modems have been on the market for approximately five years, and only recently have prices become sufficiently attractive for a mass market to develop. Similarly, a product could be too simple, such

16 At minimum, this list provides a useful starting point for a more careful discussion of how one identifies a "good" or "successful" standard.

17 Many have argued that both the ISDN and OSI standards are no longer useful or appropriate due to their tardiness. It is very possible that these standards, on which millions and perhaps billions of dollars have been spent by users, vendors, and others, will never be a significant market force.

that it does not perform the range of functions required by the end users of the technology.

Well Written A well-written standard is unambiguous, easy to comprehend, concise, and complete. Failure to meet these criteria results in a standard that is open to interpretations due to incompleteness or ambiguity, which results in potentially incompatible implementations.

Fair Fair, in the sense used here, means that the standards setting process is not biased *a priori* to dominant firms, so that new entrants have an equal voice. See Lehr (Lehr 1992) for a more complete discussion of this.

In much of the analysis that follows, we will equate the motivation of payment for intellectual property, via fees and royalties, with the ownership of intellectual property. At the current time, any patent-related fees accrue to the organization that owns and contributed the technology to the standard. Document royalties, if there are any, normally accrue to the SDOs. It is important to ask several questions related to this current fee structure: Are the costs for standards development allocated fairly throughout society? What is the basis for IP ownership? Should any changes be made?

The costlier a product is to develop and implement, the costlier the product will be in the marketplace. If the product development costs are increased due to royalty payments to the SDOs on all forms of IP, then the social benefit of the standard is reduced. Thus, from a market perspective, it is critical that costs be minimized. Additionally, in accordance with the public goods literature, the costs should be allocated such that those who benefit the most from this public good (the standard) should pay the most.

It is also useful to briefly consider the basis of *any* royalty payments to SDOs from the point of view of current copyright law.[18] The work of developing a standard is performed by volunteers (from the SDO's point of view). Thus, the SDO cannot legitimately claim creative contributions to the standard. The bases for IP ownership by the SDO are:

1. that the standards are considered "works for hire," hence the SDO owns the work;
2. the committee members and the SDOs are engage in "joint work," in which case both the SDO and the committee participants own the copyright;
3. the work is considered a "compilation" by the SDO, in which case the copyright belongs to the SDO as the assembler of the component parts of the compilation (*i.e.*, the standard); or
4. the committee participants collectively assign the rights to the IP (particularly the copyright of the standard itself) to the SDO.

The "works for hire" and "compilation" paradigms are perhaps the most solid bases. The Copyright Law (17 USC 101) states that a work for hire is either created by an employee within the scope of employment or a work that is specially commissioned or ordered. When the SDO proposes development of a new standard, it could be said that they are commissioning a work. The code does not specify the nature of the contract, so the fact that the contributors to the standard are volunteers may be irrelevant (although this may not have been tested in court). Weiss and Sirbu (1991) have argued that a standard consists of a collection of technologies. Thus,

18 The normative social basis is another matter entirely that we do not address here.

there is some basis to consider that a standard is, indeed, a compilation. In this case, the compiler owns the copyright of the compilation, even though the individual contributors own the copyright on their contributions (17 USC 201). Since it was the committee that performed the compilation, not the SDO, it is unclear that this is an appropriate basis under the law.

B. Consensual Development of Intellectual Property in Committee

In the arena of anticipatory standards, it is possible to develop patentable or copyrightable intellectual property in the standards committee. In this case, the rights to the property might belong to the organizations sponsoring the individuals involved, the individuals themselves, or the organization sponsoring the standard development, *i.e.*, the SDO. In general, standards developers work full time for organizations that support their time and effort in the process. At the same time, it is often true that individuals contribute time and energy well beyond that of the normal work day. Finally, the SDOs provides services to these volunteers to support their standards development efforts. The primary services provided are control of due process, secretarial support, and publication service after the committee has concluded its work.

Regardless of the allocation of any funds derived from licensing fees or royalties, and assuming that such fees were at a level in accord with the general policies of ANSI, we may ask how the levying of such fees and the existence of claimed intellectual property might impact the adoption of a given technical compatibility standard. We propose that IP policies impact the standardization process in the following ways:

Accessibility	A standard is less accessible if it is more costly. Collection of software royalties or licensing fees increases the cost of applying a standard, making it less accessible.
Timeliness	It is not clear that the development of a standard can be accelerated by changes in IP. If it can be, it would be a result of the fact that more timely development would result in wider adoption which would yield more royalties or licensing fees to the recipients of such fees. To the extent that this benefit is in the consciousness of the participants in a positive fashion, a motivation would exist. In fact, lack of a defined IP protection policy may delay a standard, because each case must be negotiated separately.
Appropriateness	Appropriateness could be affected if the IP protection policies were inadequate for contributors. The current ANSI policies appear to be adequate and appropriate for this category, when applied to the traditional standards setting mode.
Well Written	Clarity of writing seems unrelated to IP protection. Many copyrighted works are not well written and many are. As above (in *Timeliness*), to the extent that clarity impacts adoption and to the extent that the participants are aware of this, there might be some minor impact. While it is easy to see how participants might work harder or faster, it is less clear that they would or could "write better."
Fairness	This factor does not appear to be impacted by this change.

C. Considerations and Policy Regarding Conformance Tests as Derivative Works

Let us assume the *status quo*, that any royalties for derivative works would go to the same party that receives any royalties for the primary work.[19] In the case of standards documents, all available royalties accrue to the SDOs. Given these assumptions, the implications of conformance tests as derivative works must be explored.

At the basis of this discussion is the principle that the costlier a product is to develop and implement, the costlier the product will be in the marketplace. If the product development costs are increased due to royalty payments to the SDOs on all forms of IP, then the social benefit of the standard may be reduced. In reference to the five attributes we proposed above, we assess the impacts of these kinds of royalty payments to be:

Accessibility	As in the case of adoption and implementation, a standard is less accessible if it is more costly. Royalties increase the cost of implementing a standard, hence making it less accessible.
Timeliness	It is unlikely that the onus of preparing a standards document in accord with the formal description languages that would allow for automatic derivation of conformance test suites could do anything to speed the development process. Indeed, we believe that it is likely that this goal will delay the development of standards in this category.
Appropriateness	Appropriateness is unlikely to be affected.
Well Written	Clarity of writing, in terms of its formality is likely to be positively impacted by royalties for conformance tests as derivative works. The link between a standard and a conformance test is more likely in the case of a standard written in a formal specification language. If a standard is correctly developed, the development of the conformance test should be mechanical. The use of LOTOS, Estelle, or TTCN makes the conformance test development process more mechanical. For example, TTCN acts as a high level language to describe the details of the testing procedures. The actual test sequences and low level software that are implemented in the testers are often generated automatically using a TTCN compiler.
Fairness	This factor is not impacted by this change.

The SDOs have two major sources of revenue: membership dues and publications. These two cost categories are propagated to consumers as though they were a tax. If royalty income from conformance testing were included in the SDO revenue stream, they could either increase their costs (*i.e.*, pay higher salaries, have nicer offices, *etc.*), increase their services, decrease their dues, or decrease their royalties on document sales.

19 It is not clear that this is the best approach to revenue allocation. In software, significant value can be added to licensed software, so that the original work is valuable where it was not before (OTA 1986).

IV. Conclusion and Recommendations

When considered from the viewpoint of the changing life cycle of information technology standards, new intellectual property issues appear to the research community. We are not legal scholars, so we are unable to argue the details of current intellectual property law and its interpretation. As standards researchers, however, we are able to discuss the consequences of some of these issues.

As pointed out in the OTA report (OTA 1992a), significant issues face standards developers today. In addition to the issues documented in that report are the issues with respect to intellectual property that have been identified in this discussion.

At the heart of the policy analysis is how revenues derived from royalty and licensing fees are allocated. As a rule, costs can be said to be allocated fairly if those who benefit the most from a standard pay the most. Are different methods of payment for standards development fairer than others? Can we propose a scheme that is more fair than the current approach?

We can propose three approaches to fund the standards development process.

1. Under the current system (in the US), the costs are borne privately, but not necessarily in proportion to the benefits. It is possible for firms to free ride and still have access to the public good.[20] Nonetheless the current system attempts to allocate costs by extracting royalty payments for standards documents. Anyone who purchases the document thereby subsidizes the system.
2. Perhaps the opposite approach is to recognize that standards are a public good, and use public funds collected through taxation to pay for the process, as is done in some other countries. This approach relies on the taxation system for fairness and appropriate cost allocation.
3. It is possible to imagine conformance test royalties funding the process.[21] These royalties could be used by SDOs in these different ways:
   a. They could use these increased revenues to increase the staff pay, purchase nicer offices, *etc.* (*i.e.*, not use it as a reallocation, but as a revenue increase)

20 For example, a firm could refuse to pay membership fees to the SDOs, and still participate in the process. SDOs are afraid of limiting participation because of the antitrust liabilities raised in the *Hydrolevel vs. ASME* case.

21 Clearly, the details of funding are complex. To fully explore this area, arguments from the finance and marketing literature would have to be applied. For example, some standards could be "cash cows" that could fund exploratory development, while others might be "loss leaders." A detailed discussion of these mechanisms is left to future research.

b. They could increase the services provided by the SDO, which could decrease the cost of participation to the individuals and firms in the standards committees. Alternatively they could subsidize the participation of groups commonly under-represented in standards committee meetings, such as users and academicians. Either of these alternatives could have positive social implications.[22]
c. They could maintain their current level of services and decrease the membership fees but maintain royalty levels on standards documents, which would result in lower product costs; but these decreases would be offset by higher product testing costs. The difference is that the costs would be borne more rationally, since the organizations using standards more would test more.
d. Finally, they could maintain membership fees and decrease the cost of standards documents; these decreases would be offset by increases in the product costs due to testing. The useful secondary effect of this alternative is to increase the accessibility of standards documents because they would now be cheaper.

Since membership fees are fixed costs that are independent of benefit, it is socially preferable to reduce these to the extent possible. Thus, the policy that we would recommend is to use royalty increases to decrease the costs of membership in the SDO. This would cause costs to be allocated in a way that is more closely aligned with benefits received from them: the more an organization uses a standard, the greater the contribution that organization makes toward its development.

Standards are increasingly critical to the information technology marketplace. It is important that we understand the process from all perspectives: the incentives of the stakeholders, the funding of the process, the dynamics of adoption, *etc*. While some of these issues have been dealt with in the literature, several have not. We focussed our attention on the funding of the process and the role of collectively developed intellectual property. To the extent that IP can produce an income stream for its owners, it is important that we understand how income does and will relate to intellectual property in the standardization process. Based on an examination of applicable IP throughout the standards development cycle, we have identified what we believe to be some new issues related to intellectual property and its disposition. We have also conducted a preliminary exploration of some of the impacts of these issues. Being preliminary in nature, we feel we have raised as many questions and issues in this study as we have attempted to address explicitly.

22 Many discussions take place in the standards committee about how to stimulate users to be more involved in the process. Thus, it is evidently valued by the standards development community as a social good.

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