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An Analysis of Internet Standardization

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Summary

1. The development of the Internet has given rise to an unusual set of circumstances. Despite the importance of the Internet and the government's large role in the Internet's creation, the government currently plays an informal role in Internet governance. The need for standards and Internet governance has caused dozens of organizations to spring up, representing a multitude of interests. Based largely on their reputations and personal claims of authority these organizations are deciding the technical standards that will determine the future of the Internet. Thus far the system seems to be at least functional. Yet, changes may be necessary to ensure that the underlying technologies allow the Internet to continue to develop properly.
2. Part I provides an overview of the history of the Internet. Part II is a discussion of general aspects of standards. These aspects are: (1) factors that lead to the development of standards, (2) the effect which organizations have on standards, including potential successes and failures of such standards organizations, (3) the necessary characteristics for a good standards organization and (4) the value of government involvement in certain aspects of standardization.
3. Part III applies the general aspects of standards in the context of the Internet. First, a brief introduction to the organizations involved in Internet standards is given. The factors leading to standards and the successes and failures of standards organizations are then applied to six categories of Internet standards. The categories of Internet standards are: (1) Internet security, (2) electronic commerce, (3) other Internet applications and services, (4) Internet protocol, (5) domain names and (6) Internet infrastructure.

I. Brief Overview of Internet History

4. In 1969 the Dept. of Defense’s Defense Advanced Research Projects Agency (DARPA) created the first "Internet," ARPANET, consisting of four host computers.[1] ARPANET had a purely military purpose, and connected only military computers and Department of Defense contractors.[2] Several computers were added over the next few years, and DARPA continued to work on developing network software. Many different networking schemes were tried between 1969 and 1983.[3] Since the number of hosts was small, and DARPA controlled the network,

standardization was relatively easy. DARPA mandated that everyone run the same host software, or configure their computers to facilitate the network. The current networking protocol, TCP/IP, was the final result of DARPA's various networking schemes.[4]

5. DARPA's development of TCP/IP consisted essentially of the work of two people, Robert Kahn and Vinton Cerf. An important aspect of TCP/IP was an architecture that required no internal changes to link a network to the Internet, and would allow the use of new applications developed in the future. DARPA mandated that all nodes on ARPANET be connected via TCP/IP. On January 1, 1983, ARPANET host protocol was changed to TCP/IP, requiring a simultaneous change by all hosts.[5]
6. Prior to 1983, Internet development was guided almost exclusively by the Department of Defense. Following the DARPA-mandated transition to a uniform networking protocol, vendors and researchers, as well as DARPA working groups, began playing increasingly important roles in the development of the Internet. The Department of Defense required TCP/IP compatibility in many of its orders, but there was a lack of communication between users, inventors and vendors regarding how TCP/IP was supposed to work, and how it was to be used.
7. A newly created DARPA Internet organization, the Internet Activities Board (IAB), held a conference to educate vendors through tutorials, design meetings and workshops. Vendors also began attending the meetings of the new DARPA working group, the Internet Engineering Task Force (IETF). In 1988, DARPA organizations organized the first Interop trade show. Vendors were very successful in the display of their products because they had worked to make their products interoperable with all the other products.[6]
8. In addition to instructing vendors about possible applications for TCP/IP, researchers and universities began lobbying for wider access to the Internet by the research community. Many of the Department of Defense contractors were involved heavily in academia. These researchers wanted their "off net" peers to have access to the Internet as well.[7] The National Science Foundation (NSF) established a new government-sponsored network and followed ARPANET in requiring the use of TCP/IP on its network. Unlike ARPANET, however, NSFNet was a much more accessible network.[8] In 1990, ARPANET was taken out of service, and the NSFNet took over the job of providing the network backbone.[9]
9. The National Science Foundation chose to support DARPA's Internet organizations, including the Internet Activities Board (IAB)[10] and their Internet Engineering and Architecture Task Forces. Initially just one of the many task forces, the Internet Engineering Task Force (IETF) began to grow tremendously starting in 1985. Consequently, it gained prominence among the groups, and a substructure of working groups was created under it. The remaining DARPA working groups were combine into the Internet Research Task Force.[11] During this period of time there was also the development of voluntary Internet standards by private standards organizations, such as the American National Standards Institute (ANSI), in areas such as electronic data interchange (EDI) standards.[12]
10. The government's creation of the NSFNet resulted in substantial Internet growth. Researchers and developers made substantial use of the Internet, and use grew in other areas as well. It became increasingly difficult to remember the numeric addresses of all the computers on the Internet. As a result, the domain name system was developed at the University of Southern California, and

names were assigned to the host computers, eliminating the need to remember the numeric addresses.[13]

11. In 1989 the World Wide Web was created at CERN.[14] The World Wide Web initially consisted entirely of text. The creation of the Mosaic web browser at the University of Illinois in 1993 created the capability of viewing images and multimedia presentations. Current web browsers have extended their capabilities beyond the World Wide Web to ftp, telnet, and email.[15]

II. Analysis of Standardization

12. The choice of the government to mandate the use of TCP/IP is one of the most obvious instances of standardization on the Internet. The standardization of TCP/IP allowed for much of the growth of the Internet through compatibility of networking software and applications.[16] Standards may play an important role in the future of the Internet as well. Thus, it is important to have an understanding of the underlying principles of standards and standardization.

A. Factors Leading to Standards

13. Several market factors can lead to standardization. These factors are: (1) network externalties, (2) path dependence (3) compatibility factors and (4) product differentiation. Two non-market factors can lead to standards as well. First, the government might play a role in the creation of standards. An issue of particular importance to the government might cause it to promulgate standards in that area itself. Fear of government involvement might also cause industry to create standards. Second, there may be a perceived need for standardization in the industry or community itself.

1. Market Factors

14. The first category of market factors leading to standardization is network externalities. A "strong" form of network externality is one in which the value of a product to consumers is heavily dependent upon its acceptance by other consumers.[17] The telephone networks provide an example of this condition. The primary product offered by telephone companies is the chance to contact other people. Thus, the ideal telephone network is one where the maximum number of people are connected. Since sections of the network are "owned" by more than one company, standards are necessary to allow the networks, and thus the network users, to interconnect.
15. The second market factor that leads to standardization is path dependence. In some instances past decisions regarding product or standard choice will dictate the choices made in the future.[18] Use of a product requires commitment of resources that make people less likely to switch to a new product. A good example is a word processing program. Time and expense goes into learning the word processing program once it is chosen. As people grow more comfortable with a program, they become less likely to change, resulting in a "convenience" externality.[19] A further commitment involves the creation of documents and data readable by the program. Unless that data can be accessed by future programs, a user is unlikely to switch. Consequently, the word

processing program chosen in the past will limit the possibility of changing in the future.

16. The third type of market factors, compatibility factors, can lead to standards in two ways. In the first scenario, there is no dominant standard in a technology around which products are developed. Most applications will be developed to be compatible with the standard that developers expect to become dominant. Since the standard chosen by developers then has the most applications available for use with it, consumers will gravitate toward that standard as well. This, in turn, leads to more product development around this standard. The choices of standards by the developers of applications lead to the "victorious" standards in the underlying technology.
17. In the second scenario, pre-existing standards in a base technology can lead to further standards. The creation of standards in other products results from a desire for compatibility with the base standard. An example of a base technology standard resulting in product standards occurs with electrical appliances. Since standard wall outlets in the United States have two or three prongs, there is a strong incentive for manufacturers of appliances to build devices that plug in to these existing outlets. This allows manufacturers to maximize the number of consumers able to use their product.[20] As more manufacturers create products around the wall outlet standard, a standard for electric appliance plugs develops.
18. The fourth market factor, product differentiation, can also lead to further standards as the result of existing standards. Agriculture is an area where standards developed to allow product differentiation. By grading and classifying their products farmers could set up separate distribution channels and increase their profits.[21] Current environmental standards may also be used as a marketing tool for product differentiation.[22] However, one commentator has noted that this can lead to "playing the standards card."[23] As a result of the marketability of products incorporating standards, many vendors are turning their products over to standards organizations for standardization.[24] Thus, standards are sometimes created to provide a marketing edge, or to keep up with competitors who can already claim incorporation of standards in their products.
19. The fourth market factor is distinguishable from the first three factors in an important way. The first three market factors lead to a small set of standardized products with the potential to outlast the technical superiority of the product.[25] If multiple products do share the market, it will be because of their interoperability. This includes interoperability with each other, with other products upon which they are dependent, and with prior versions of their product. However, with the fourth market factor there will be a tendency to create a large number of standards, which may or may not be interoperable. These standards may eventually succumb to the first three market factors, finally resulting in a small number of standards. However, this will be in spite of, rather than because of, the fourth market factor.

2. Non-market Factors

20. Historically, the United States government has played a small role in standardization when compared to other countries. While many countries have state-coordinated national standards bodies, much of the standardization in the United States has been done in the private sector.[26] However, the U.S. government has taken the lead in setting standards in areas of great governmental interest.

21. World War I created one of the first issues of great governmental interest that lead it to pursue market standardization. Product diversity had been so great that it was hindering the war effort. Thus, the government supervised standardization in many product areas. The government's interest in standards arose again in the 1960s and 70s as the result of complaints by consumer advocates, such as Ralph Nader, regarding public safety and antitrust issues.[27]
22. The Cold War played a large role in the decision to create ARPANET.[28] The controlling position of the government continued even after the Cold War and resulted in a large role being played by the government in the development of Internet standards.[29] Finally, industry may engage in standardization or self-regulation if it fears that the government is going to regulate them.[30]
23. Occasionally the perceived need of a standard, by an industry or community, leads to the development of a standard.[31] This is particularly demonstrated among researchers and in academia. The Internet domain name system was created at the University of Southern California because of the difficulty perceived in remembering numeric addresses.[32] Scientists and engineers have also been active in standardization because of a need for accurate standards of measurement and precision instruments to take these measurements.[33] Professional ethics and quality standards are also common areas of standardization because a profession perceives a need for such rules.[34]

B. The Effect of Standards Organizations on Standards

24. If any of the factors that lead to the creation of standards are present in an area, standards will likely arise. However, the factors leading toward standards often do not limit the ways in which a standard can arise. In some circumstances a de facto standard may arise as the result of a monopoly, or the government, industry, or standards organizations may create standards. If standards organizations are going to play a large role in future standardization, it is important to recognize the potential successes and failures of standards organizations. It will then be possible to recognize situations when standards organizations need outside assistance or monitoring, or when they should be playing no role at all.

1. Potential Successes of Standards Organizations

25. The potential benefits of standards organizations appear to fall within three general topics. The first topic concerns the standards organizations' standards development processes. These processes, for various reasons, may be better and more reliable than the alternatives. The second topic addresses standards organizations' ability to capture network effects more readily than alternative methods of standardization. The third topic involves situations where the market will be an adequate standards-setting force, and standards organization could facilitate the development of de facto market standards.

a. Good Standards Development Process

26. There are a number of aspects of standards organizations that may make their standards process superior to de facto standardization or standardization by other bodies. Standardization by private organizations can be much faster and more flexible than de facto or government standardization.[35] Standards organizations may be able to combine the expertise of many people to help overcome information problems, thus improving the resulting standard.[36] Standard setting by standards organizations can help avoid some of the inefficiencies associated with de facto standardization. "[I]f a standard can be set first, before substantial development takes place, then this avoids duplicated R&D costs, standards wars[37], and stranding[38]. It reduces the uncertainty about the new standard, so that manufacturers and complementary producers can then develop products in a stable environment."[39] Finally, the standard that might be most objectively desirable for society might not be a standard that would arise from an equilibrium in the market.[40]

b. Capture of Network Effects

27. Standards organizations also may, in some circumstances, be better than the alternatives at capturing network effects. In industries that tend toward standardization, standards have a "winner take all" quality that disproportionately rewards the developer of the "winning" standard.[41] This standard can then be priced at whatever the developer wishes, despite the fact that the optimal "network effects" result might occur at a lower price that would allow widespread adoption of the standard.[42] The members of industry will also waste considerable resources in trying to win the standards race.[43] Finally, if left to the market, insufficient standardization might occur. "Much of the economic benefit of an incremental increase in network size does not accrue to the incremental network member but is shared by all members of the network."[44] Thus, market actors may have no motivation to standardize, despite the gain that society as a whole would realize. Standards organizations could be in a better position to recognize and develop socially beneficial standards.
28. A solution to this problem of capturing "network effects" is to make standards interoperable. Interoperability can be achieve in at least three ways. The first possible solution would be to interpret intellectual property laws to preclude companies from enforcing intellectual property rights in a standard. This could be a difficult system to administer. Administration of such an intellectual property system would require attention to the problem of providing adequate incentives for initial development in areas with a tendency toward standardization. As a second solution, the government could set the standard and legislate compliance for all market participants subject to its authority to comply.[45] However, the government may be ill-suited to determining the best standard, and there is a much lower likelihood of "leapfrogging"[46] over an objectively poor standard. The third possibility is a standard setting organization. A standards organization could produce "tipping" if its members have sufficient market share.[47] A standards organization may also be more market-oriented than a government agency. Standardization by a standards organization also may be more efficient than de facto standardization, since having multiple companies utilizing a standard can mean increased competition.[48] Thus, having

standards organizations may be the best means of capturing network effects.

c. Assistance of the Market

29. Compatibility factors are an aspect of the market that can lead to standards. One method by which compatibility factors lead to standards is through the gravitation of developers of applications to a particular technology. However, for this to occur the developers of applications must anticipate that a particular standard will become dominant. If it is difficult to predict which technology will become dominant, developers and consumers may adopt a "wait and see" approach. They will wait for a technology to become dominant before making a choice themselves, to avoid being stranded. If many people adopt the "wait and see" approach, it is unlikely that a technology will become dominant, and no standard may arise.[49]
30. The choice of which technology is expected to become dominant would be facilitated if the preferences of other users and developers were known. Standards organizations can facilitate exchanges of information, and thus allow developers and users to be confident in adopting a particular technology. Further, the endorsement of a particular standard by a standard organization, even a voluntary standard, could create a focal point for users and developers. The endorsement of the standards organization could help differentiate between similar technologies, allowing for a standard to arise through the functioning of the market.

2. Possible Failures of Standards Organizations

31. There a number of circumstances where standards organizations could fail. These circumstances can be addressed in three general situations: (1) when a standards organization has unbalanced representation of interests, (2) when there is a lack of leadership in the standards community and (3) when the community is exceptionally diverse.

a. Unbalanced Representation of Interests

32. A potential problem related to representation of affected interests occurs when there is an unbalanced representation of interests among large and small companies or interests. Some of these potential failures can be dealt with as antitrust issues.[50]
33. For example, the standards set by an organization dominated by large interests could be used to the detriment of small interests. Courts look at whether the members making the standard are competitors of the disadvantaged party when considering the such effects.[51] Lower courts often look at the purpose behind the standards, and then determine if the standards are reasonably related to this purpose, and are objective. Procedural safeguards and the opportunity for all potentially affected interests to be heard can also play an important role in determining intent or motive of an organization's actions.[52]
34. Membership requirements could be a means by which smaller interests are kept out of standards organization. With a sufficiently high membership fee, or other membership rules, small interests may be unable to join. While courts have recognized that organizations must have some type of

limiting rules, the collective action denying membership must be intended to accomplish a goal justifying self-regulation, and must be reasonably related to that goal.[53] When faced with such a situation, courts consider whether the members making the decision to exclude were direct competitors of the excluded party. If so, the court may find an unlawful concerted refusal to deal.

35. On the other hand, organizations that have no membership requirements whatsoever, or allow only one representative of any organization regardless of size may result in under-representation of large interests. Dilution of the influence of large interests could result in standards that are not accepted by them. If the large interests then act on their own, through tipping they might be able to produce a de facto standard, rendering the organization's standard meaningless. Alternatively, the industry could be stuck with an objectively bad standard that happened to benefit small interests.
36. A final circumstance addresses unbalanced representation of non-industry interests in the standards organization. Standards organization may provide the opportunity for joint activity by competitors leading to agreements in restrain of trade. The best economic interest of an industry may not always coincide with the best interests of consumers, researchers or the government. These groups could be disadvantaged if they are not allowed to participate in standardization.

b. Lack of Leadership in the Standards Community

37. A second problem that can arise with standards organizations involves a lack of leadership. There are currently many standards organizations that function independently of one another in the creation of standards. Many of the advantages of organizational standard-setting could be lost if multiple organizations have competing standards. Notably, the exchange of information would be limited, and there would be no guarantee of compatibility among standards. Enforcement of any one standard would be particularly difficult. Further, since the end result may tend to be a single standard anyway, competition among standards organizations for the use of their standard may be inefficient.[54] Lack of leadership could also result in overlapping and underlapping jurisdictions. Without leadership, multiple groups could create conflicting standards covering the same protocol or application. Since organizations would only be standardizing in their particular area of interest, there could be significant gaps between areas of standardization.
38. Several issues lead to lack of leadership in the standards community. First, there may be disagreement about who develops the best standards.[55] Second, some standards organizations sell their standards. An organization's desire to sell its own standards may prevent cooperation with other standards organizations on shared problems. Third, the interests of standards-setters may be divergent from those of manufacturers.[56]

c. Excessively Diverse Interests

39. A final shortcoming of standards organizations can occur when the diverse interests of the affected parties makes achieving consensus difficult or impossible.[57] There are some situations where a gain for one community is a loss for another.[58] In a "zero-sum" situation there will always be winners and losers.[59] This could make it impossible to achieve consensus among the

affected parties. In other circumstances it may be possible to achieve consensus eventually, but the diversity of the parties means that "unproductive factiousness results instead of productive synergy."[60] The divisiveness of excessively diverse interests may result in a slow administrative process for the standards organization, and loss of much of the speed and flexibility that standards organizations could provide. A slow process could mean that the market will have arrived at a de facto standard by the time the standard organization's standard is developed.[61]

C. The Elements Necessary for Good Standards Organizations

40. There are situations where standards organizations can be beneficial to the creation of standards. However, the mere existence of an organization to create standards is not enough. The characteristics of the organization must be conducive to the successful development of good standards. There are many traits that are important for a standards organization to be successful. These traits seem to fall with four general characteristics that are necessary for a successful standards organization: (1) an effective internal structure, (2) the participation of all affected parties, (3) organizational accountability and (4) a means of enforcing the organization's decisions.

1. Effective Structure

41. The standards-producing success of an organization will depend heavily on the reliability of its procedures. If the standards developed are to embody the purposes underlying the standard, the process must provide means to test potential standards for signs of reliability and use of sound logic.[62] The system used to create standards should also be evaluated periodically to ensure that it remains effective.[63] Additionally, decision makers must have adequate technical knowledge and access to any information about the industry that would assist them in developing a standard.[64]

2. Participation by Affected Parties

42. The second element is participation by all affected parties.[65] In particular, it is important that consumer groups be represented. Such representation will encourage the presentation of all relevant information, and may help give the decisions of the group legitimacy in the eyes of consumers.[66] For this participation to be meaningful, there must be adequate notice to affected parties and an organization that is not biased against particular perspectives.[67] It is also necessary that the participants have a clear understanding of the structure of the organizations, including the standards process and an appeals process.[68]

3. Organizational Accountability

43. Accountability in the organizational structure can be provided in a number of ways. One

important element of this is the means of electing the organization's leadership.[69] The ability of affected parties to elect decision-makers can promote the legitimacy of the organization's decisions. It is important that the relationship between organizations and their leadership be clearly defined and this information be made accessible.[70] External accountability is also important. Consultation of outside interests, such as industry or other organizations, justification for the actions taken and the availability of an appeals process can provide external accountability.[71] These factors can also provide legitimacy for the decisions of the organization.

4. Means of Enforcing Decisions

44. The final element of an ideal standards organization is a means of enforcing the organization's decisions.[72] An organization may not have the ability to control the conduct of its members. It is even less likely that it will be able to control the conduct of outsiders. The means of enforcement need not be rewards and sanctions administered by the group itself. Under certain circumstances the market alone could provide adequate rewards and punishments to enforce the decisions of the organization.[73]

D. Role to be Played by the Government

45. There are many reasons for the government to play a role in standardization. In many countries the government plays a large role in coordinating the creation of standards on a national scale. The government is an affected party in many areas of standardization.[74] Finally, the government may be able to play a role in mitigating or eliminating some of the potential failures of standards organizations. This participation could be implemented in varying levels of formality. The government could choose to fund a standards organization, to participate in the standards process, to facilitate or coordinate standardization by existing organizations[75], or to create and mandate its own standards.
46. The government already plays a role in handling unbalanced interests in standards organizations. Certain activities engaged in by standards organizations violate antitrust laws, and the government intervenes to enforce those laws. Historically, the government has also ensured the representation of the interests of consumers and researchers in standardization and development of technology. At the behest of consumer advocates the government addressed health and safety standards.[76] The government aided the interests of researchers and academics that were left off ARPANET by its establishment and funding of NSFNet.[77]
47. Alternatively, the government may serve to insulate standards organizations from antitrust liability in some circumstances. The Noerr-Pennington doctrine[78] applies some antitrust protection to activities of organizations involved in petitioning legislatures, adjudicative bodies and public officials. Thus, the existence of a government organization involved in the recommendation of standards could provide some antitrust protection for standards organizations petitioning this body.[79]
48. Further, fear that government participation in standards organizations could lead to an imbalance

of interests in favor of the government may be unwarranted. Office of Management and Budget (OMB) guidelines state that government agency should not use participation in voluntary standards development as an opportunity for the agency to dominate the standards development process. The agency representatives should participate only to the same extent as industry participants, and should not "seek to dominate such groups." Further, the OMB guidelines anticipate that these standards bodies could produce standards not in accordance with the agency's goals, despite agency participation.[80]

49. Governmental involvement could also address problems of leadership and excessive diversity. "[In] many other countries ... unified national standards bodies were established in conjunction with the state..."[81] Government oversight could establish clear roles for the standards organizations, and avoid the problems of over- and underlapping jurisdictions. The government could also intervene and mandate acceptance of a given standard when excessive diversity prevented the development of the standard by an organization. "There are ... some standards which may be beneficial but need to be co-ordinated centrally by an authority which sees the whole picture, particularly for changes to a standard... In cases such as these there may be a need for government intervention to co-ordinate and regulate the standards process."[82]
50. Government involvement could also facilitate enforcement of standards. In many instances the standards organization may not have direct control over all parties affected by the standard. If the government were involved in the standards process, even informally, it could be a logical choice for enforcement of the standards. Governmental involvement could also provide legitimacy for the standards decisions in the eyes of affected groups not directly involved in the standards process.

III. Internet Standardization

51. Within the general analysis of standards governmental interest, perception of a need, and the functioning of the market can lead to the development of standards. Both standards organizations and the government have important roles to play in the development of standards. Before analyzing standardization on the Internet it is useful to have an introduction to the organizations involved in Internet standards. The general principles of standards may then be applied to the Internet.

A. Internet Standards Organizations

52. There are two primary groupings of Internet standards organizations: the "traditional group" and the "modern group." In addition to the two groups of organizations, there are many standards organizations that work independently.
53. The "traditional group" consists of organizations with long-time involvement in standardization which eventually entered the area of Internet standardization. The traditional group organizations are: the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), the International Electrotechnical Commission (IEC) and the International Organization for Standardization (ISO) joint technical committee on information technology (JTC

1), and the International Telecommunications Union (ITU).

54. The "modern group" arose specifically around the Internet. These groups tend to be much newer than those of the "traditional group." The modern group organizations are the Internet Engineering Task Force (IETF), World Wide Web consortium (W3C), Internet Architecture Board (IAB), Federal Networking Council (FNC), Internet Assigned Numbers Authority (IANA), Internet Society (ISOC), Internet Engineering Steering Group (IESG), Internet Research Task Force (IRTF), and Corporation for National Research Initiatives (CNRI).
55. Both group contain one large organization that standardizes in most areas (ANSI in the traditional group and IETF in the modern group), as well as a mid-sized organization that standardizes in multiple, but generally not all, categories (IEEE in the traditional group, W3C in the modern group). The other organizations participate in various ways to varying degrees. These groups have little formal communication with each other, although standards created by one organization are occasionally used as a starting point for a standard in another. For example, IETF may incorporate ANSI or IEEE standards in its standards, or use them as a starting point for its standardization.
56. In addition to the traditional and modern groups, there are many standards organizations that work independently. While they do occasionally work in cooperation with either the traditional or modern group, most of their standardization activities occur without outside involvement. The independent organizations often form around a specific area of interest, and concentrate on standardization in that area.

B. Specific Markets

57. Within the general analysis of standards it is clear that a number of factors can lead to the development of standards. Standards organizations and the government have different roles to play in different circumstances. These general principles can be applied to the Internet.
58. One commentator noted that a difficulty in analyzing the information infrastructure comes from its nature as "a hodgepodge of public and private telephone networks, private local and wide area networks, mainframe- and mini-computing centers, and numerous communication bridges between various subnetworks."[83] The solution is to focus on "one 'economic network' at a time."[84] The areas of standardization that will be considered are: (1) Internet security, (2) electronic commerce, (3) other applications and services, (4) the Internet protocol, (5) the domain name system, and (6) the Internet infrastructure.

1. Internet Security

59. One major area of interest is Internet security. Internet security involves issues of privacy and security of information on the Internet. It also includes encryption programs that provide increased security for information traveling on the Internet, as well as processes to reduce the transmission rate of important information, such as passwords.
60. Much of the work on Internet security is done by large and mid-sized organizations.[85] Other organizations, such as Secure Electronic Marketplace for Europe (SEMPER), involved with electronic commerce and are often involved with security. End to End Security (E2s) is one

organization dedicated solely to Internet security issues.

61. It is important to note that the area of Internet security may not have the same tendency toward standardization. Network externalities have substantially less of an impact in the area of Internet security. Encryption standards are not made more valuable by increased usage. In fact, concern over too many people having access to a decryption key has historically been a major concern of Internet security.[86] The advent of public-key cryptography has largely eliminated this problem.[87] However, the elimination of harm from publication of a decryption key does not automatically lead to network externalities. The nature of public-key cryptography is such that the user of a particular program or encryption algorithm does not derive any added value from others' use of the same program or algorithm. With public-key cryptography it is still necessary for the user to distribute the public keys associated with each unique private key.[88] Users must find a way to distribute their personal public keys, regardless of the number of people using the same encryption program or algorithm. Further, a number of encryption algorithms and programs can provide the same level of security.[89] Thus, it does not appear that the use of any particular encryption program or algorithm will cause any security benefit to accrue to the other users of that program or algorithm.
62. Network effects may play a role in the distribution of public keys. The holder of a private key must find a way to distribute the public key to those who want it. Those wishing to find an individual's public key must know where to find it. A key certification authority, or key distribution center[90] could provide a centralized location for public keys to be deposited and located. The distribution center could act as an intermediary between encryption users in the same way that yellow pages act as an intermediary between telephone buyers and sellers. As more public keys are deposited at the distribution center, the center becomes more valuable to those seeking public keys. Users seeking public keys will then refer to this distribution center more frequently, increasing the center's deposit value to private keyholders. Thus, it appears that network effects could play a role in encouraging the emergence of a standard key distribution center.[91]
63. Despite the absence of a natural tendency toward standards in many aspects of encryption, there may be de jure standardization as the result of governmental interest. Internet security is an area of extremely high government interest. Government interests include law enforcement and international espionage implications, protection of corporations from industrial espionage, and protection of individual privacy. Law enforcement access to information, such as a drug dealer's records, and protection of classified government information, are commonly recognized governmental interests in the area of computer security.[92] However, equally important are governmental interests in adequately securing private information, belonging to corporations and individuals, from unauthorized access. Thus, the government role would be an attempt to maximize the security provided to businesses and individuals, while minimizing the risk that law enforcement would be unable to access information critical to an investigation. Because of the magnitude of the interest, government involvement may be appropriate. A good context for this involvement is in the area of key certification authorities, as this area has the greatest natural tendency toward standardization.[93]

2. Electronic Commerce

64. Electronic commerce involves monetary transactions taking place via the Internet, use of electronic currency, and other issues encompassing the intersection of money and technology. Electronic commerce is the specific focus of many different organizations.[94] Because of the number of participating organizations and the undeveloped nature of the market, it is difficult to predict which organizations will be most influential in this area. It is likely that the influence of large organizations, which is considerable in most areas of standardization, will carry over into the area of electronic commerce.
65. Electronic commerce appears to have standards-driving market effects present. Network externalities will certainly be a factor in electronic commerce. Success of electronic cash depends on its acceptance by many businesses. Following this acceptance, consumers will be confident that they can use electronic cash when they making purchases. This in turn, will likely cause an increase in the number of businesses accepting electronic cash. The expansion of electronic commerce seems dependent upon its widespread acceptance.
66. Compatibility will be a factor as well. If businesses are willing to transact, but technical incompatibilities with electronic cash exist, they will be unable to transact. Thus, the effective number of participants will decrease, reducing chances of success.
67. The fact that electronic commerce is such a new market will affect the impact of path dependence. Scarcity of past decisions should minimize constraints on future decisions. However, as electronic commerce develops and matures, constraints could become a problem.
68. Electronic commerce is susceptible to standardization. Various vendors and service providers will likely compete heavily as the market begins to grow. Thus, standards will likely be used for product comparison and differentiation.
69. Although electronic commerce is of great interest to the government, a minimal governmental role in its development might be appropriate. Electronic commerce could be an incredibly important market in the future. It might also become a means to efficiently utilize time. Commerce transacted on the Internet is less dependent upon the availability of workers, and thus can be carried on at all hours of the day or night.[95] However, Ira Magaziner reported an appropriate role for the government in this area.[96] His report argues for a minimal government role, allowing the private sector to lead. Minimal government involvement, such as stimulating the private sector to standardize or providing a legal framework when necessary, is entirely appropriate.[97] Within these limits, it might be appropriate for the government to play a role in the enforcement of standards.
70. It is not clear that standards organizations should play a large role in the area of electronic commerce. Electronic commerce is likely to be the most market-dependent feature of the Internet. Many standards organizations may not be sufficiently sensitive to these market aspects to create adequate standards. Customer preference will play a large role in this area.[98] Thus, the best role for standards organizations might be a focus on compatibility through the development of the most basic, underlying technologies, while allowing the market to determine everything else.

3. Other Internet Services and Applications

71. With the growth and commercialization of the Internet came the development of many services and applications. These applications include web browsers, search engines and utilities for printing and faxing via the Internet. Involvement in services and applications is at a very high level. Large standards organizations such as the American National Standards Institute (ANSI) and the Internet Engineering Task Force (IETF) participate in this area. Additionally, a large number of small and mid-sized organizations participate in this area.[99] Some of the most notable organizations include, the World Wide Web Consortium (W3C) (which is involved in standardization of all applications and services associated with the World Wide Web) and Open Group (which promotes open Internet standards[100] in any area where applications are being created).
72. Market factors leading to standards are present in the area of services and applications. An application, such as Internet fax, provides the opportunity to contact others. For an Internet fax to be successful, it must connect as many people as possible. Compatibility may play a role as well. There may also be a need to make the Internet fax compatible, not only with other Internet faxes, but with traditional faxes as well. Thus, current fax data standards may affect the standards for Internet faxes. The initial choice of a transmission format may limit the future options. Competing vendors may also attempt to "play the standards card" with regard to other aspects of the technology. The same could apply to other applications, such as Internet printing and Web browsers.
73. When considering standards organizations role in services and applications, the problem of over- and under-lapping jurisdictions is particularly evident. A large number of organizations exist, many of which are standardizing in the same area, creating the potential for conflicting standards and problems with any one body enforcing the standards. Conflicting organizations will limit the sharing of information. Competing standards will provide no single basis for all vendors to use in product development. Further, these organizations all standardize in areas of interest to their members, creating the potential for gaps in areas that might have important technical aspects, which are not the focus of any organization. Oversight by the large standards organizations might be sufficient to address issues of conflicting jurisdictions and gaps in jurisdictions. However, the government might also be an appropriate a body to unify standardization and support enforcement.
74. The majority of applications and services (such as coordinating calendars over the Internet, printing over the Internet, or creating extensions to ftp to allow use of languages other than English) do not seem to be of great importance to the government. Some specific applications or services, such as Internet gambling and sites providing illegal pornography, are of interest to the government. However, these types of services are largely unaddressed by standards organizations.[101] Thus, governmental participation in this area through membership in standards organizations would likely not address many of the areas of governmental interest. By overseeing standards development, the government could encourage consideration its concerns as well as resolve issues of over- and under-lapping jurisdictions.

4. General Internet Market Analysis for Internet Protocol, Domain Names and Internet Infrastructure

75. The remaining categories, Internet protocol, domain names and Internet infrastructure all underlie the basic functionality of the Internet. Market analysis for these areas involves application of the market factors to the Internet generally. To the extent that market factors will lead to a standardized, interoperable Internet, the standardization will occur in the areas of domain names, Internet protocol and Internet functionality.
76. It seems clear that network externalities exist on the Internet. The Internet is similar to the telephone network. Its product is connection to other people.[102] Thus, the more people that are connected to the network, the more valuable a connection becomes. Thus, maximized connectivity strongly motivates interoperability of separately owned "pieces" of the Internet.
77. This desire to maximize the connectivity of people on the Internet also raises issues of compatibility. It is not enough that users be able to connect, but they must also be able to interact. This necessitates interoperable file transfer protocols or web browsers.
78. Path dependence might also be a factor on the Internet. For example, choice of web programming languages affects future decisions. If substantial resources have gone into the creation of web pages using a particular language, programmers will be less willing to change to another language. However, one commentator noted that, "[i]f the rapid growth of the Internet continues... new users [not constrained by past decisions] may overwhelm the users of the old standard, causing the old standard to be replaced over time."[103] Therefore path dependence may be less of an issue with the Internet than in more mature markets.
79. In general, the basic structure of the Internet is less susceptible to standardization for marketing purposes. However, there have been prominent examples of vendors applying for standards to gain a market advantage.[104] Standardization for marketing purposes will likely play a role. It is not clear how large that role will be.

a. Internet Protocol

80. Internet protocols function on the Internet in much the same way that mailing addresses function in mail. Internet protocols utilize the Internet address[105] to transmit data to the correct location and ensure proper data handling. The current Internet protocol is Internet Protocol version 4 (IPv4). Because of the limited number of Internet addresses available with IPv4, the Internet Engineering Task Force (IETF) believes that all addresses will be used up in the near future. IETF has been developing a new Internet protocol, Internet Protocol version 6 (IPv6) to replace IPv4. Expected features of IPv6 include a larger number of Internet addresses, autoconfigurability of Internet addresses and increased security.[106]
81. IPv6 provides a good example of backwards-compatibility. Given the current number of Internet users, it might be logistically impossible for a simultaneous switch to IPv6. Consequently, IPv6 was made compatible with the current IPv4. Potential for future problems exists if significant numbers of users stay with IPv4. IPv6 was intended to simply extend IPv4. However, future changes to the Internet protocol may require incorporation of elements incompatible with IPv4. If the need for backwards-compatibility holds back this Internet protocol, a technologically outdated protocol version might remain in use due to commitment of resources.
82. Internet protocol is an area where the large size of the Internet Engineering Task Force (IETF) has

slowed standardization. The large number of participants has slowed development of this Internet protocol much more than previous versions.[107] It is possible, however, that slower development is appropriate. The Internet Engineering Task Force (IETF) is essentially alone in its standardizing efforts in this area. Therefore, competition among standards is not an issue. If allowing input from all affected parties results in a slower standards process, it may result in better standards.[108]

83. Governmental interest in this area may be somewhat higher than governmental interest in domain names. Law enforcement has an interest in being able to track a hacker's trail through the Internet (as pen registers might provide for phone calls). This could conceivably be accomplished through the IP. Vulnerabilities of critical infrastructures to hackers might also be addressed in this area.[109] However, government interest is much higher in other areas; thus only a moderate level of government involvement may be warranted. IETF is providing adequate leadership of standardization in this area, with a large number of participants. If all the participants in the Internet Engineering Task Force change to IPv6, there should be little problem with enforcement. However, the backwards-compatibility of Ipv6 may result in many people staying with the current Internet protocol, Ipv4. If this happens, government enforcement or encouragement of the switch to Ipv6 could be valuable.

b. Domain Names

84. Each Internet address has a domain name associated with. This makes the address easier to remember.[110] The Domain Name System (DNS) handles the associations between Internet addresses and domain names. A user typically needs only to use a domain name. The computer will refer to a database that provides it with the Internet address linked to the domain name. The computer will then connect to that Internet address.[111]
85. NSI currently manages the distribution of domain names under the generic top-level domains.[112] NSI handles domain name registration by managing the Registration Services project of the InterNIC organization.[113] Because anyone can register any unused domain name, there have been conflicts between the owner of a trademark, and someone who registered a domain name utilizing that trademark.[114]
86. In response to the trademark problems, and a desire to expand the number of organizations involved in the registration of domain names, several plans to change the domain name registration system have been developed. The most prominent plan has come from the International Ad Hoc Committee (IAHC), a group of representatives of several international standards organizations.[115] The IAHC plan calls for the creation of seven top-level domains and the addition of 28 domain name registrars. The World Intellectual Property Organization would resolve all disputes associated with domain names. This plan has been criticized as being too narrow, and developed too quickly by a group that was not sufficiently representative of all interests.[116] Network Solutions has proposed its own plan. Under this plan it would still register domain names under the ".com" top-level domain, but other organizations would register names under the other top-level domains.[117] NSI opposes IAHC’s plan to change the domain name

distribution system and add new domain names.

87. One of the primary problems in this area has been insufficient input from affected parties. IAHC did not contain representatives from a sufficient number and type of interests.[118] The prominent player in domain name registration, NSI, was not a member of IAHC. Further, NSI is a company, not a standards organization, and thus has little input from affected parties.
88. Several other problems exist with the domain name registration system. The current domain name registration system is subject to balance problems. The current distribution method may tend to favor large businesses over small businesses and individuals.[119] Further, the general lack of leadership in the Internet standards community is particularly evident in the domain name area. It may be appropriate for the government to provide leadership, if only on an interim basis, to end the conflict among organizations. A process allowing the input of all affected parties and providing legitimacy is necessary before the decision will be implemented by the Internet community.
89. Government interest in this category varies widely from issue to issue. While there is governmental interest in the domain name record-keeping,[120] and the issue of trademark infringement in domain names, there is likely less interest in the domain name system itself. Lessened interest seems to imply an informal role for the government in the area of domain names.
90. Enforcement of the trademark issues may not be practical either. Many countries have national registration of trademarks. Thus an impartial international body might be in a better position to adjudicate the competing interests of trademark owners.[121] An existing international body, such as WIPO, could play such a role.[122] Or, a new organization could be formed to adjudicate domain name disputes.

c. Internet Infrastructure

91. Internet Infrastructure concerns involve the routing of information and the transmission of data over the physical wires and cables that make up the Internet. They are largely related to the functional aspects of telecommunications in general. Thus, many of the organizations working in this area are traditional organizations.[123] Many of these are industry organizations.
92. There are generally less conflicts and more cooperation in this category than the others. This area is more mature than other aspects of the Internet. Additionally, there is less conflict because the standards organizations working in the Internet infrastructure areas have been working in similar areas for many years. However, there may be continuing problems associated with leadership and under-lapping jurisdictions. Due to the tendency of standards organizations to be representatives of industries or particular interests, standards developed by these organizations may leave gaps where no single industry is currently focused. The International Organization for Standardization (ISO) and the International Electrotechnical Committee (IEC), in which most of these groups participate in some form, may provide sufficient leadership to minimize the problem of overlapping jurisdictions.
93. The Internet infrastructure in particular may present concerns about balance and antitrust issues. It is sufficiently dominated by industry groups and industry's representatives that joint agreements in

restraint of trade could be a problem. Large interests could manipulate membership requirements in industry organizations to prevent small interests from joining. Inability to participate in a standards organization could leave small interests unrepresented in the standards process and potentially disadvantaged by resulting standards.

94. As in the telecommunications industry, there is government interest in the Internet infrastructure. The potential for physical or "cyber" threats to critical infrastructures are of major concern to the government. Damage to critical infrastructures, such as telecommunications, electrical power systems, banking and finance, could have a substantial impact on national defense or economic security.[124] However, the maturity of the organizations standardizing the Internet infrastructure area indicate the that current government telecommunications involvement mechanisms adequately represent its interests.[125]

IV. Conclusion

95. Unlike its beginnings as a small network controlled by a government agency, the Internet has become a vast network of diverse interests competing to control its future. The interplay of these forces leads the Internet toward standardization. However, without sufficient participation, guidance and authority Internet standards organizations will be unable to continue the legacy of exponential growth and development. An increased role for government could be valuable in many areas. Government involvement can ensure its interests are represented, and assist in the representation of other interests. Government involvement may also be able to address many of the potential shortcomings of standards organizations.

Footnotes

[*] Marcus Maher, J.D., Harvard Law School, 1999. I thank David Goldstone for helpful comments and criticism.

[1] *See* Barry M. Leiner, et al., *A Brief History of the Internet*, (last modified Feb. 20, 1997) <http://www.isoc.org/internet-history/brief.html>; Henry Hardy, *The History of the Net*, (last modified Dec. 14, 1994) <http://www.ocean.ic.net/ftp/doc/nethist.html>.

[2] *See* Jack Rickard, *The History of the Internet*, *Boardwatch*, June 1995 ¶10 (July 16, 1997) <http://www.boardwatch.com/mag/95/jun/bwm1.htm>.

[3] *See id.* at ¶7.

[4] *See id.*; Leiner, *supra* note 1.

[5] *See* Rickard, *supra* note 2.

[6] *See* Leiner, *supra* note 1.

[7] *See* Rickard, *supra* note 2, at ¶10.

[8] The National Science Foundation did develop and administer an Acceptable Use Policy limiting access to non-commercial uses. However, the policy was vague, and there were only a few instances where the National Science Foundation enforced the policy. *Id.* at ¶12.

[9] *See* Hardy, *supra* note 1.

[10] This organization is now the Internet Architecture Board (IAB).

[11] *See* Leiner, *supra* note 1.

[12] *See* John C. Yates, *Electronic Commerce and Electronic Data Interchange*, 471 PLI/PAT 233, 240 (1997).

[13] *See* Leiner, *supra* note 1.

[14] *See* Rickard, *supra* note 2, at ¶16.

[15] *See id.* at ¶17.

[16] *See* Leiner, *supra* note 1.

[17] *See* Michael L. Katz and Carl Shapiro, *Network Externalities, Competition, and Compatibility*, 75 AM. ECON. REV. 424 (1985).

[18] *See* S.J. Liebowitz and Setphen E. Margolis, *Path Dependence, Lock-In, and History*, 11 J. L. ECON. & ORG. 205 (1995); Mark J. Roe, *Chaos and Evolution in Law and Economics*, 109 HARV. L. REV. 641 (1996).

[19] This externality may not be very great individually, but collectively it can have a large effect. *See* Mark A. Lemley, *Antitrust and the Internet Standardization Problem* 28 CONN. L. REV. 1041, 1050 (1996).

[20] *See id.* at 1047.

[21] As farmers moved west, they labeled their products by region of origin, and wholesalers used the terms "Goschen butter," "Genessee flour" and "Herkimer cheese" to designate grade. *See* Linda Garcia, *Standard Setting in the United States: Public and Private Sector Roles*, IEEE MICRO, Dec. 1993 at 28.

[22] *See ISO 14000: Enviro-marketing tool? USA: ISO 14000 may be just another marketing tool, but may also become a prerequisite for ISO 9000*, InTech, June 1, 1996, *available in* 1996 WL 9865662.

[23] *See* Richard Karpinski, *Vendors Play the 'Standards' Card*, NETGUIDE, July 1, 1997, *available in* 1997 WL 8980847.

[24] These include Netscape, Sun Microsystems Inc. and Microsoft. *See id.*

[25] *See* Lemley, *supra* note 19, at 1052. Another slightly less important distinction is that the first three market factors can lead to either the creation of de facto standards by a monopolist, or creation of de jure standards by standards organizations. However, the fourth market factor will lead to standardization of an industry-developed technology by a standards organization. *See id.* at 1064 (discussing the de facto or de jure standards resulting from the first three market factors).

[26] *See* Garcia, *supra* note 21, at 28.

[27] *See id.* at 29-32.

[28] *See* Rickard, *supra* note 2, at ¶6; Hardy, *supra* note 1.

[29] *See supra* text accompanying notes 1-11.

[30] Fear of government involvement is the most common reason for self-regulation with regard to disciplinary rules. *See* Cosmo Graham, *'Self Regulation' in* ADMINISTRATIVE LAW AND GOVERNMENT ACTION at 189, 195 (Genevra Richardson and Hazel Genn, eds., 1994). However, it seems clear that government intervention is a fear that leads to standardization as well. *E.g.*, Cross-Industry Working Team executive director, Charles Brownstein, Remarks at the Meeting of the Washington D.C. chapter of the Internet Society (June 8, 1997) (stating that standards organizations and industry should create standards for network service before the government decides to regulate).

[31] *See* Graham, *supra* note 30, at 195.

[32] *See supra* text accompanying note 12.

[33] *See* Garcia, *supra* note 21, at 29.

[34] *See*, e.*g.*, Timothy Stolzfus Jost, *The Necessary and Proper Role of Regulation to Assure the Quality of Health Care*, 25 HOUS. L. REV. 525, 534-558 (1988) (discussing self-regulation and quality-of-care standards in the medical profession).

[35] *See* Graham, *supra* note 30, at 194.

[36] *See id.* Information problems are present particularly in situations of a diffuse market structure. With a diffuse structure it may be difficult for potential users and suppliers to coordinate on technical interoperability, and the result is a number of non-interoperable products. It can be particularly difficult to get standardization efforts started, since few people are willing to risk the unrecoverable initial costs of development without wide support for the potential standard. *See* Shane Greenstein, *infra* note 63, at 38-39.

[37] Standards wars occur when the developers of competing technologies expend resources in an attempt to gain sufficient market share to have their technology emerge as a de facto standard. The resources expended in promoting the technology not ultimately accepted as the standard are wasted.

[38] The users of a technology losing a standards war will be "stranded" with a technology for which there will be no further support or development, and that is incompatible with the technology which has become the standard. At some point these users will incur the expense of transferring their information to the new, incompatible technology.

[39] *See* Peter Grindley, *Regulation and Standards Policy: Setting Standards by Committees and Markets*, *in* THE REGULATORY CHALLENGE 212, 218 (Matthew Bishop et al. eds., 1995). However, producers of competing technologies may expend resources in a competition to have their standard adopted by a standards organization. This competition will reduce the savings realized from the elimination of marketplace standards wars. *See id.*

[40] *See* Stanley M. Besen and Garth Saloner, *The Economics of Telecommunications Standards*, *in* CHANGING THE RULES 177, 185 (Robert W. Crandall and Kenneth Flamm eds., 1989).

[41] *See* Lemley, *supra* note 19, at 1059.

[42] *See id.* at 1060.

[43] An example of this occurred in the railroad industry from 1860-1910. There was substantial growth in the railroads, but the increase in the railroad's capacity was not done efficiently. Rather, all the railroads pursued their "empire building" in an attempt to become the sole provider of rail services. Thus, substantial overbuilding occurred. *See* Dennis W. Carlton and J. Mark Klamer, *The Need for*

Coordination Among Firms with Special Reference to Network Industries, 50 U. CHI. L. REV. 446, 458 (1983).

[44] H. LANDIS GABEL, COMPETITIVE STRATEGIES FOR PRODUCT STANDARDS 175 (1991).

[45] *See* Lemley, *supra* note 19, at 1060-2.

[46] In the market generally, leapfrogging can occur when a dominant product has faced the need of backwards compatibility over time, and has become large and difficult to change. It is then vulnerable to a competitor who, facing no such restrictions, is free to make a product that is a dramatic improvement over the old standard, leading consumers and developers to change despite the switching costs. With government standards, adherence is mandated, thus no market participant can chose a superior standard. *See id.* at 1057-8.

[47] If a large portion of the market used a particular standard, then most applications would be created to be compatible with this standard. Other market participants might then move to the standard used by the majority of the market to take advantage of the applications made for that standard. This would result in a larger percentage of the market using the standard, and even more applications being created to be compatible with the standard.

[48] *See id.* at 1063-5.

[49] *See* Stanley M. Besen, Compatibility Standards, Competition, and Innovation in the Broadcasting Industry 11-12 (1986).

[50] In addition to the problems created by antitrust violations, the threat of antitrust lawsuits can be problematic. For, example, during the process of developing a standard for television stereo, one of the competitors, Telesonics, threatened to sue the industry trade group for creating a standard that would disadvantage Telesonics in the marketplace. This threat delayed standards deliberation. *See id.* at 61-5.

[51] *See* Antitrust Law Developments 86,87 (Willard K. Tom et al. eds., 3d. ed. 1992)*; see also* Allied Tube & Conduit Corp. v. Indian Head, Inc., 486 U.S. 492 (1988) (imposing Sherman Act liability on a member of a fire safety association for influencing the association to adopt a safety code designed to benefit its products); Am. Soc'y of Mechanical Eng'rs v. Hydrolevel Corp., 456 U.S. 556 (1982) (holding an association liable for the acts of its agents to use safety standards against one company at the request of a competitor).

[52] The exact nature or extent of the procedural safeguards has not been clearly specified. *See* Antitrust Law Developments, *supra* note 51, at 88-90.

[53] *See id.*

[54] *See* Garcia, *supra* note 21, at 33. For a specific example see Carlton and Klamer, *supra* note 43, at 458.

[55] Professional societies' standards may be technologically superior, but those of industry groups may be more reflective of the market. *See* Garcia, *supra* note 21.

[56] Again, the issue of sale of standards may be important. While industry might want to give away some standards to ensure widespread acceptance, an organization whose livelihood depends upon sale of standards may be unwilling to do so. *See id.*

[57] "[T]he more divergent are the interests of the participants, the less likely it is that a consensus will emerge." *See* Besen, *supra* note 40, at 185.

[58] *Compare* Robert D. Cooter, *Decentralized Law for a Complex Economy*, 23 SW. U. L. REV. 443, 450 (1994) for a discussion of normative failure when a public good for one community is a public harm for another community.

[59] One example of such conflict occurred in the context of high-definition television. Ground-based broadcasters felt threatened by high-definition television which is best transmitted by satellite or cable. Further conflicts occurred between the existing Japanese standard and the interests of Eurpoeans who rejected the standard in order "to protect the remnants of their consumer electronics industry." *See* Grindley, *supra* note 39, at 215.

[60] *See* John R. Allison, *Rule-Making Accuracy in the NCAA and its Member Institutions: Do Their Decisional Structures and Processes Promote Educational Primacy for the Student-Athlete?*, 44 U. KAN. L. REV. 1, 14 (1995).

[61] This occurred with the competition between Adobe Systems' PostScript document format and Xerox's rival format standard. After two years a standards committee approved a standard that was a combination of the two formats. However, by this time PostScript had been adopted by the market, and the committee's standard meant nothing. *See* Julie Pitta, *Format Wars*, Forbes, July 7, 1997, at 266.

[62] *See* Allison, *supra* note 60, at 13.

[63] *See id.* at 14; Greenstein, *Markets, Standards, and the Information Infrastructure*, IEEE MICRO, Dec. 1993, 36, at 38.

[64] *See* Jost, *supra* note 34, at 532.

[65] *See e.g.*, Graham, *supra* note 30; Allison, *supra* note 60, at 13; Robert W. Hamilton, *The Role of*

Nongovernmental Standards in the Development of Mandatory Federal Standards Affecting Safety or Health, 56 TEX. L. REV. 1329, 1345-6 (1978); David A. Wirth, *Reexamining Decision-Making Processes in International Environmental Law*, 79 IOWA L. REV. 769, 772 (1994).

[66] This sense of legitimacy could come from the added accountability provided by consumer group participation, and by the decreased likelihood of "capture" by industry.

[67] Notice and impartiality, in addition to participation, are associated with ideas of "due process." Notice must be adequate to inform all affected parties, and early enough to allow them to participate in the entire process. Forms of bias that can be particularly harmful include "an economic or emotional stake in the outcome of a decision, an individual or class-based hostility or favorable predisposition toward an affected party, an emotional desire for revenge or vindication against an affected party, unyielding ideological convictions, [or] a desire to make one's job easier...." *See* John R. Allison, *Combinations of Decision-making Functions, Ex Parte Communications, and Related Biasing Influences: A Process-Value Analysis*, 1993 UTAH L. REV. 1135, 1138 (1993). *See also*, Wirth, *supra* note 65, at 772, regarding participation.

[68] *See* Hamilton, *supra* note 65, at 1346; Andrew Updegrove, *Forming and Representing High Tech Consortia: Legal and Strategic Issues*, 11 NO. 3 COMPUTER LAW. 8, 13 (1994). These aspects can be particularly important in the consideration of antitrust issues. *See supra*, text accompanying notes 50-51.

[69] *See* Allison, *supra* note 60, at 14. There are several approaches that have been taken in this regard. These include "economic models (those who pay the highest dues get most or all of the board seats), arbitrary solutions (the first members to join receive the seats, while later members may stand in line for a turn-over opportunity), as well as models which place a premium on democratic values (seats are allocated to types of members ... in order to ensure that all interest groups are heard from), or upon preserving the appearance as well as the reality of neutrality (e.g., only nonaffiliates of members can become directors to ensure that the standards adopted are "pure")." *See* Updegrove, *supra* note 68, at 13.

[70] *See* Graham, *supra* note 30, at 197.

[71] *See id.* at 193. This appeals process may include an appeal to an "ombudsman" who investigates, and may be more or less independent of the organization, or an appeal to an independent organization. *See id.* at 200-201.

[72] *See id.* at 193; Allison, *supra* note 60, at 7; Jost, *supra* note 34, at 534.

[73] For example, if the members of a standards organization collective had a significant market presence, their use of a standard could have a "tipping" effect, causing the rest of the industry to switch to the standard. *See* Lemley, *supra* note 19, at 1064. The threat of market impact of damaged credibility could also help enforce decisions of standards organization. Loss of credibility would occur if the participants

in standards development renege on their agreements to adopt or provide its technology for a standard. For long-term participants in the market, the economic effects of this loss of credibility could act as an enforcement mechanism for standards organizations. *See* Besen, *supra* note 49, at 65 (discussing loss of credibility in the context of telecommunications standards).

[74] *But cf.* Grindley, *supra* note 39 at 223, 225 (asserting that success of a standard could be negatively affected by attempts to incorporate industrial policy in the standard). Analytically, the negative effects need not result solely from industrial policy, but also from attempts to incorporate any policy goals, including political policies, in a standard. Thus, attempts to incorporate government policies in a standard would likely be seen by Grindley as harmful to the potential success of the standard.

[75] The Office of Management and Budget (OMB) issued guidelines for the involvement of governmental agencies in the development of voluntary standards, identifying exactly these roles. The appropriate roles identified by the OMB are: "(a) Direct financial support; e.g., grants, sustaining memberships, and contracts; (b) Administrative support; e.g., travel costs, hosting of meetings, and secretarial functions; (c) Technical support; e.g., cooperative testing for standards evaluation and participation of agency personnel in the activities of standards-developing groups; and (d) Joint planning with voluntary standards bodies to facilitate a coordinated effort in identifying and developing needed standards." *See* Leon E. Panetta, *Circular Number A-119*, (visited January 5, 1998) <http://www.whitehouse.gov/WH/EOP/OMB/html/circulars/a119/a119.html>.

[76] *See supra* text accompanying note 17.

[77] *See supra* text accompanying notes 7-8.

[78] For an overview of the Noerr-Pennington doctrine, *see* Daniel R. Fischel, *Antitrust Liability for Attempts to Influence Government Action: The Basis and Limits of the Noerr-Pennington Doctrine* 45 U. CHI L. REV. 80 (1977).

[79] Most lower courts apply the "rule-of-reason" analysis to product standard-setting by private associations. The Supreme Court has held the party bringing the antitrust claim has the burden of showing that the anti-competitive effects outweigh the pro-competitive benefits of the standard setting (rule of reason), or of showing the standards are neither governmental action nor incidental to legitimate attempts to influence governmental action. However, efforts to enforce private standards face more stringent antitrust analysis. *Allied Tube & Conduit Corp. v. Indian Head, Inc.*, 486 U.S. 492, at 497-501 (1987).

[80] *See* Leon E. Panetta, *supra* note 75.

[81] Garcia, *supra* note 21, at 28.

[82] Grindley, *supra* note 39, at 217.

[83] Greenstein, *supra* note 3, at 37.

[84] *Id.*

[85] These organizations include the American National Standards Institute (ANSI), the Internet Engineering Task Force (IETF), and the World Wide Web Consortium (W3C).

[86] "The key agreed upon by two partners determines in classical cryptosystems both the encryption step and the decryption step in a simple way, which is symmetric in the sense that both times essentially the same effort is needed.... [C]ryptanalytic security depends on the secrecy of this key." Friedrich L. Bauer, DECRYPTED SECRETS 171 (1997). *See also* Bruce Schneier, APPLIED CRYPTOGRAPHY 47-8 (1996).

[87] *See* Schneier, *supra* note 86, at 4-5; *see also* Arto Salomaa, PUBLIC-KEY CRYPTOGRAPHY 55 (1996). While public-key cryptography is less susceptible to attack by using the encryption key to determine the decryption key, it is susceptible to other forms of attack. *See e.g.*, Schneier, *supra* note 86, at 48-9.

[88] *See* Schneier, *supra* note 86, at 48. Consequently, there is no added security benefit from a standard encryption program or algorithm.

[89] *Cf.* Salomaa, *supra* note 87, at 64-71 (discussing the construction of public-key cryptosystems).

[90]*See* Schneier, *supra* note 86, at 42-3 (or a brief description of how a key distribution center would work).

[91] It should be noted that given the current state of technology there would seem to be an upper limit on the number of users that a particular key distribution center could have before the value of the center would begin to decrease. Search engines have been unable to manage the large quantity of information on the Internet, and have given up trying. *See* David Brake, *Lost in Cyberspace*, NEW SCIENTIST, Jun. 28, 1997, at 12. However, advancements in the technology of managing large databases could allow the value of the key distribution center to increase without limit as more public keys are deposited.

[92] *See, e.g.*, Janet Reno, et. al., *A. Letter from Attorney General Janet Reno and others to Members of Congress regarding law enforcement's concerns related to encryption*, (last modified July 18, 1997) <http://www.usdoj.gov/criminal/cybercrime/aglet.wpd>.

[93] This is, in fact, the government's current approach. Pending legislation in the Senate, Secure Public Networks Act, S. 909, 105th Cong. (1997), would regulate key certification authorities to ensure governmental access to encryption keys.

[94] These organizations include Collision Industry Electronic Commerce Association (CIECA), Commerce Net (CN), Distributed Applications Research and Technology (DART), Data Interchange Standards Association (DISA), E-Co System, European Initiative in Electronic Commerce (EIEC), Financial Services Technology Consortium (FSTC) and Secure Electronic Marketplace for Europe (SEMPER).

[95] *See* Linton Weeks, *In U.S., Nighttime is the Right Time; 24-Hour Businesses are Making Odd Hours Ideal for Doing Errands*, The Washington Post, July 20, 1997, at A1.

[96] *See A Framework for Global Electronic Commerce*, (visited July 7, 1997) <http://www.iitf.nist.gov/eleccomm/ecomm.htm>.

[97] *See id.*

[98] Some customers may prefer a complex, yet very secure process, while others may prefer something slightly less secure that is simpler. Neither of these is objectively better, thus creation of a standard may not be appropriate.

[99] These organizations include The European Association for Standardizing Information and Communications Systems (ECMA), the European Workshop on Open Systems (EWOS), the Federal Networking Council (FNC), the National Committee for Information Technology Standards (NCITS), the National Institute of Standards and Technology (NIST), and Trans-European Research and Education Networking Association (TERENA).

Several organizations focus on standards from a particular perspective. These are the Coalition for Networked Information (CNI) which focuses on academic and research uses for the Internet, and Macintosh Internet Developers Association (MIDAS), which is focused on Internet issues related to Macintosh use and applications development.

[100] "Open" (as opposed to proprietary) standards may be freely used by anyone creating a product.

[101] A notable exception is PICS, a controversial system for filtering Internet content. *See Platform for Internet Content Selection* (last modified Jan. 3, 1998) <http://www.w3.org/PICS>.

[102] This connection may be to people themselves, as with email or chat rooms, or connection to resources people have created, such as their web pages or ftp sites.

[103] Lemley, *supra* note 19, at 1051.

[104] Netscape has moved to turn JavaScript over to a standards body in what has been characterized by

one commentator as "a typical standards-card ploy." Also, Sun Microsystems Inc. plans to submit Java to the International Standards Organization (ISO), and Microsoft submitted ActiveX to the Open Group. *See* Karpinski, *supra* note 23.

[105] An Internet address consists of four numbers separated by periods, each number less than 256. Internet addresses look like this: 125.223.13.1 *See* Ed Krol, The Whole Internet: User's Guide & Catalog 30 (2d ed. 1994).

[106] *See* Rob Glenn, et al., *Project: IPv6 Technology* (last modified Apr. 11, 1996) <http://snad.ncsl.nist.gov/ant-proposals/proj-ipv6/proj-ipv6.html>.

[107] Due to an increase in participation, mainly among vendors, IETF's standards process has been slowed dramatically. The turnaround time for IPv6 has been about two and one-half years. Some have said this process should realistically take only about one and one-half years. *See IETF Faces Growing Pains, Internet Magazine,* Aug. 1997, at 30.

[108] Some IETF officials are considering potential solutions for the problem, but they are not pursuing any organizational changes at this time. "[T]he IETF prides itself on hearing all sides of an issue before deliberating on a decision." *See id.*

[109] *Cf. PCCIP Background Page* (visited June 23, 1997) <http://www.pccip.gov> (discussing the governments interest in protecting critical infrastructures such as telecommunications, banking, etc., from physical and "cyber" threats).

[110] A domain name is a string of characters connected by periods, such as: ww.law.harvard.edu. *See* Krol, *supra* note 105, at 30.

[111] *See* Krol, *supra* note 105, at 30-3.

[112] The generic top-level domains are ".com," ".edu," ".gov," ".org," ".mil" and ".net." There are many other organizations involved with national top level domain names such as ".us" in the United States, or ".de" in Germany. *See* Krol, *supra* note 105, at 32.

[113] *See About the InterNIC,* (visited July 31, 1997) <http://www.internic.net/internic/>. For Network Solution's domain name registration and use policy see *NSI Domain Name Dispute Policy Statement,* (last modified Nov. 1995) <ftp://rs.internic.net/policy/internic/internic-domain-4.txt>.

[114] *See e.g., Zippo Manufacturing Company v. Zippo Dot Com, Inc.*, 952 F. Supp. 1119 (W.D.Pa. 1997); *Panavision Int'l. L.P. v. Toeppen*, 945 F. Supp. 1296 (C.D.Cal. 1996); *Planned Parenthood Fed'n of Am., Inc., v. Bucci*, No. 97 Civ. 0629, 1997 WL 133313 (S.D.N.Y. Mar. 24, 1997) (lawsuits involving the use of a trademark in a domain name).

[115] The International Ad Hoc Committee (IAHC) included representatives from the Federal Networking Council (FNC), the International Telecommunications Union (ITU), the International Trademark Association (INTA), the Internet Assigned Numbers Authority (IANA), the Internet Architecture Board (IAB) and the World Intellectual Property Organization (WIPO). The International Ad Hoc Committee (IAHC) dissolved itself, and replaced itself with the interim Policy Oversight Committee (iPOC). *See IAHC* (last modified May 26, 1997) <http://www.iahc.org>.

[116] *See Domain Name Reformers Press on in Geneva; U.S. Remains Silent, But IAHC Critics Mount*, 2 Elec. Info. Pol'y & L. R. (BNA) No. 19, at 486 (May 9, 1997).

[117] Other registrars could register under the other top-level domains on a first-come, first-served basis initially administered by the FCC. *See NSI's Domain Name Reform Plan Allows Competition for New Top-Level Domains*, 2 Elec. Info. Pol'y. & L. R. (BNA) No. 16, at 428 (Apr. 18, 1997).

[118] IAHC included representatives from the Federal Networking Council (FNC), Internet Assigned Numbers Authority (IANA), the International Telecommunications Union (ITU), the Internet Architecture Board (IAB), the International Trademark Association (INTA), the Internet Society (ISOC) and the World Intellectual Property Organization (WIPO). *See supra* note 115.

[119] *See Domain Name Rights Coalition* (visited June 20, 1997) <http://www.domain-name.org/intro.html>.

[120] Domain name record keeping could be important if, for example, law enforcement wanted to find out who the domain name for an Internet gambling site was registered to.

[121] *See e.g.*, David W. Maher, *Trademark Law on the Internet -- Will It Scale? The Challenge to Develop International Trademark Law*, 16 J. Marshall J. Computer & Info. L. 3 (1997) (discussing the potential problems of international trademark disputes over domain names, and noting the value of a uniform international trademark law).

[122] The WIPO is the organization that would be responsible for resolving domain name disputes under the International Ad Hoc Committee's domain name plan.

[123] Organizations from the traditional group include the American National Standards Institute (ANSI), the Institute of Electronic and Electrical Engineers (IEEE), the International Telecommunications Union (ITU) and the International Eletrotechnical Committee/International Organization for Standardization (IEC/ISO) joint technical committee on information technology (JTC 1).

Other organizations include the Corporation for Research Initiatives (CNRI), particularly its Cross Industry Working Team (XIWT), the Commercial Internet Exchange (CIX), the European

Telecommunications Standards Institute (ETSI), the Telecommunications International Association (TIA), the Internet Research Task Force (IRTF), the National Industrial Information Infrastructure Protocols (NIIIP) and the Research Program on Communications Policy (RPCP).

[124] The President's Commission on Critical Infrastructure Protection (PCCIP) is evaluating this problem. *See PCCIP Background Page, supra* note 109.

[125] *See e.g.*, Kevin Werbach, *Digital Tornado: The Internet and Telecommunications Policy*, (OPP Working Paper No. 29), (last modified Mar. 1997) <http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp29.pdf> (discussing the role to be played by the FCC in the future of the Internet).