known. But there is, I believe, cause for concern if the at least relatively "neutral" service offered by libraries is not among the options for seekers of information in the networked environment.

15.   Conclusions

Integrity and Access Issues in the Broader Networked Information Context

Before attempting to summarize or draw conclusions from the material covered in this paper, it is vital to put the issues reviewed here in perspective. This report has concentrated on problems and open issues. In some cases it sketches a rather bleak picture, particularly in regard to the role of libraries as publishers move towards electronic information products. It has outlined a growing array of threats to information consumer privacy in the networked environment. Indeed, the purpose of the report is to highlight these issues and problems.

It is important to recognize and address these issues precisely because the potential of networked information is so significant. Realizing this promise is of central importance. Information technology and network-based access to a rich array of information resources can change our educational institutions (in the broadest sense not only of elementary and higher education, but of lifelong learning), our political system, our economic frameworks, and our culture. Visions of futures in which our children, anywhere in America, can browse storehouses of knowledge and cultural history available from electronic library collections, define goals which we collectively believe worthy; the question before us is how to achieve these goals. If the potentials were not so great, the issues defined here could be left to the evolving marketplace in electronic information and the continual redefinition of institutional roles that this marketplace is driving. But I believe that the promise of networked information demands conscious, deliberate choices, and, where necessary, investments to support these choices.

The other point that should be stressed is that we are in a very complex transitional period which is likely to continue to at least the end of the century. This is not only a transition from the traditional print publishing system (including the role of libraries in that system) to a system of electronic information distribution, but also to some extent a transition away from the existing system to new models for creating and controlling access to content. For example, government (at the federal, state or local level) may well commission the creation of content for use by the public, or license access to content on behalf of the public because access to this content is an essential element in the educational system (again, in the broadest sense of elementary, higher, and adult education). Authors may choose to make their creations widely available at little or no cost simply because they believe that access to these creations is of great importance to society, or because they are writing to communicate ideas rather than to make money. A new information distribution system, enabled by the ability of the network to make every participant a publisher and to disseminate materials in electronic formats widely and at very low cost, is starting to grow up alongside the traditional publication system even as this system of publication is itself transfigured. Depending on an author's goals in creating a given work, he or she may choose the traditional, copyright-controlled system based on publishers or the one of the new network-based

publication models as a distribution channel. Within this new, parallel, information distribution system using the network libraries will take on new roles and missions. This is a time of great creativity and experimentation, of exploring new roles and new models.

We are seeing signs that economics alone will not define the shape of the future. For example, in a networked environment there is a very strong tendency to centralize resources; the extreme case of this is the vision of a centralized electronic library in a given discipline that provides service worlwide.[90] While there are strong economic justifications for this sort of centralization in a networked environment since the presence of the network eliminates geographic-based use community affiliation and permits economies of scale that are amortized across national or international user communities, the predicted centralization is not clearly taking place. Rather, the networked environment is giving rise to a very pluralistic model of information storage and access; at one level, this is inefficient, as a good deal of information is stored redundantly, but at another level this is a comforting development since it re-enforces the value that we as a society place on distributed, democratic access mechanisms that lack central points of control. We have yet to fully comprehend the resolution of the conflicts between economics and cultural/institutional values.

Similarly, the destruction of the existing interlibrary loan system is not an entirely forgone conclusion; as authors, particularly authors of scholarly works, become more aware of the consequences of their actions, they are beginning to protest the confines of the existing scholarly publication system and in at least a few cases to explore alternatives, such as various forms of network-based electronic distribution of their works. There is a growing recognition that the publication system that has developed to support scholarship, teaching and research over the past centuries exists to seine these communities rather than to define their function. There is a perception within the research and higher education communities that they can define the future that they wish to live in, and that the members of these communities are responsible for defining that future. For example, I expect that there will be serious and occasionally bitter debates among the boards of scholarly societies in the next few years as the communities to which these societies are ultimately accountable wrestle with questions about whether these societies will have roles similar to for-profit publishers (perhaps subsidizing other activities of the society with profits from publication programs) or whether they will return to their original functions of facilitating communication and diffusion of new knowledge within scholarly communities, even if this means distributing their publications at little or no cost on the network and loosing the revenue that these publications generate (and presumably finding new financial models for supporting the society's activities and publications). This reevaluation of the roles of the existing system of publication in meeting the needs of the scholarly community is likely to be painful and acrimonious, since whatever their origins both commercial scholarly publishers and many professional societies which function as publishers are now very large and profitable businesses that will resist changes diminishing their size, income and influence.

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90 Technically, such a facility is likely to be mounted on multiple hosts, probably at multiple sites, 'n order to provide some redundancy in case of disaster and to permit scaling to very large user communities. But, organizationally, the model is one of a single monolithic institution providing access to information.

As we look beyond the research and higher education communities, the picture becomes less clear, as the motivations of key stakeholders become more clearly profit-oriented and the sense of accountability to a community becomes weaker. When one considers the role of advertising, and the corporations that advertising serves in the development of the electronic mass media to date, one cannot be sanguine about predicting a future in which these media are held directly accountable for furthering the public good. Perhaps we can see the start of a divergence here between the research and education community and the general information consuming public (recognizing of course that many individuals participate in both communities to a greater or lesser extent at various points in their lives). The research and education community, which ultimately creates and can control most of the information it uses, is beginning to take responsibility for its own transformation into the networked information environment. On the other hand, the populace as a whole (including the public library system that serves this general populace) does not in any real sense create the information that it consumes, or control this information except in the most indirect ways (the power of the consumer's dollars in the marketplace and the power of the consumer's vote in developing public policy); content and the means of access to information are controlled by relatively unaccountable organizations like commercial corporations. In the general case, we are a society of information consumers who view ourselves at the mercy of information providers. The electronic information world of the general public may well be defined primarily by entertainment video libraries, interactive games, shop-at-home services that substitute for the printed catalogs that clog our mailboxes today, and "infotainment" segments advertising the latest in personal growth, weight loss, business success, and the like, with market researchers lurking in the wings to accumulate (electronic) mailing lists of qualified prospects. Here it is important that libraries, government information, and information from the scholarly community, as well as many diverse viewpoints from the general public on issues of importance maintain a presence among the information sources offered to the general public through the network, even if, following the patterns of today's broadcast mass media and print publications, such materials are only modestly used by the general public. Ensuring this continued presence is an important public policy objective. There is considerable precedent for this; for example, in the broadcast media the offerings of the Public Broadcasting System are not typically the highest rated programming, but they are offerings that make important contributions to our society in many different ways.

There is no question in my mind but that we will solve the problems and address the issues raised in this paper. The progress of information technology is inexorable; the promises and advantages compelling and the payoff enormous. It is clear that the private sector has now recognized the potential marketplace that networked information of various types represents, and has begun to commit massive financial resources to develop this marketplace. If not already the case, the scope of this private sector commitment will soon overwhelm the resources that the research and education community and the government have already contributed to seed and nurture development of the networked information environment. This will create additional pressures to address and resolve the issues quickly. It may also introduce a new pragmatism and expediency into the development of these solutions; while academics and policy makers sometimes debate issues at great length, the need to ship products,

launch services and recover investments is a great motivation to come up with some sort of practical solution and get it implemented in a timely fashion. The growing private sector pressures will also create considerable tensions and controversies, since solutions acceptable in the commercial marketplaces (and desired by the private sector) may not be entirely acceptable to the research and education community or to makers of public policy.

The challenge before us, then, is to ensure that we address the issues and solve the problems in the most timely way possible while, to the maximum extent possible, incorporating and balancing the interests and concerns of public policy, of the research and education community, and the private sector in these solutions. Speed is important; without timely progress we face the risk of being overrun by marketplace developments, which are not likely to reflect the balance of interests that I believe is essential for a future that will offer not only the commercial payoff but also the improvements in research, education, and the extent to which the public is informed. And balance is also vital: the interests of the various sectors involved are in many cases conflicting, and a deliberately and thoughtfully crafted balance among them will be needed to achieve the future that we desire. The importance of developing this balance is too great to be left entirely to the chance and marketplace forces.

Ensuring Access to Information in the Networked Information Environment

Publication, whether in print or in electronic form, is the act of making a unit of information available to the public, perhaps at some price. These individual units represent intellectual property for which the authors and/or publishers are frequently compensated. This is as it should be. At the same time, when all of these publications are aggregated, they form a major part of our societal, cultural and scholarly record and serve as a repository for our collective knowledge. Ensuring that our children, scholars, researchers, indeed all of our citizens, have some reasonable level of access to this collective body of information both when it first appears and even many decades later is a vitally important public policy objective. Today, this public policy goal is implemented by the provisions of the copyright law and by institutions such as libraries. The copyright law and the doctrine of first sale help to ensure that libraries exist and can effectively function; however, with some relatively modest exceptions, while the operation of libraries seems to be generally accepted as a public policy goal, the libraries of America are enabled more than they are mandated by specific federal legislation.

As this paper has shown, the mechanics of "publication", its legal framework and perhaps even its definition are changing in important ways in the electronic environment. Further, as has been discussed, new forms of information rather different than the traditional published works collected by libraries are taking on increased importance: these include the contents of the electronic mass media and also the so-called secondary information sources (such as abstracting and indexing databases) which, when joined with the searching capabilities of computers, provide new and powerful tools for managing and navigating the growing primary literature. The public policy goals of creating and maintaining a reasonable level of citizen access to the published literature remain, but we may need to find new ways to achieve these goals. There are questions both of access to relatively current material and continued access

to the societal and scholarly record in the long term. This changing legal framework is making it very difficult for libraries to continue to fulfill the functions that they have traditionally performed in support of these public policy goals. Either changes must be made to permit libraries to continue to perform these functions, or some new or redefined set of institutions must be established and empowered to do so. There are many possibilities, some of which have been at least superficially mentioned in this paper, including changes to the copyright law (such as mandatory licensing), the creation of increased amounts of information or licensing of information at a national level, or changes to the depository provisions of the copyright law to ensure that copies of electronic works are registered with some institution responsible for their long term preservation. One can imagine a number of other legislative or regulatory approaches to addressing these issues.

One of the problems today is the general uncertainty surrounding intellectual property law as it relates to electronic information. This sense of uncertainty is both inhibiting progress and driving some developments that may well be undesirable from a public policy point of view (such as the increased use of contract law and licensing to control electronic information). Resolving these intellectual property questions in the courts will be a very slow and costly process and one that only increases the sense of uncertainty and risk surrounding electronic information. One alternative would be legislative action to clarify the issues and in some cases perhaps implement specific changes in support of public policy objectives. But, in an area as complex as intellectual property law changes will have to be made with great care and great wisdom; further, because intellectual property laws potentially impact so many areas of the economy and society (and also have important international implications) it may be difficult to develop a successful consensus on changes driven by the needs and public policy objectives related to networked information within this much broader community. There are other possible ways to make progress and reduce uncertainty, such as guidelines developed among the stakeholders which do not have the force of law, but which provide generally agreed upon rules of acceptable behavior; the model of the National Committee on New Technological Uses of Copyrighted Works (CONTU) with regard to the development of guidelines for interpreting the copyright law in the context of new technologies may be relevant here. CONTU both helped to clarify and obtain some consensus on issues, and also paved the way for subsequent legislative changes.

The purpose of this paper, however, is to make the reader aware of the growing problems in achieving the public policy goals related to access in an environment that is increasingly moving towards electronic information, and to provide background for an informed discussion of solutions, rather than to explore the ramifications of the various proposed solutions in detail. These problems are real and growing. But, I believe that our strength here is that as a society we have a reasonable consensus on the public policy goals, though there will always be debates about how much access is enough and how such access should be financed, as well as the nature of the implementation mechanisms and the continual tuning of the balance between rightsholders and the public.

Finally, I would note that federal government information has a very special role in the developing networked information environment. If it is made publicly available at little or no cost it will be a very widely used and important information source in the networked environment. Indeed, the creation and distribution of inexpensive high quality

information resources can be an effective instrument of public policy; one need only consider the enormous impacts that databases like MEDLINE from the National Library of Medicine and ERIC from the Department of Education have had in vastly improving access to and use of published information in the biomedical and health sciences and education respectively [U.S. Congress, 1990]. Federal leadership in information policy related to the electronic distribution of public information would also be helpful to state and local government in developing policies and recognizing the advantages that networked information access and distribution offer. Finally, large amounts of federal information can be used as a testbed for developing and proving standards, technologies and systems without the complexities, costs or limited and closed user communities that would typically be required if licensed commercial information was used in such experiments.

Privacy, Confidentiality and Anonymity in Access to Electronic Information

If there is relatively good consensus on the importance of access to information to our society, I believe that there is much less consensus about issues related to privacy, confidentiality, and rights to anonymous access. This lack of consensus goes far beyond simply access to the published works and to the societal and scholarly record, and is clearly seen in the many public policy debates related to privacy and confidentiality generally (for example, credit reporting, medical records, public records, computer matching of various types of files, debates about cryptography) as well as the conflicts between the cultures and perhaps values of libraries, the computing and computer networking communities, and the commercial world that have been illustrated here. The ability of information technology to provide easy access to and permit the analysis of vast amounts of information has implications that we are just beginning to understand. Further, as this paper has illustrated, there are many subtle questions related to the use, compilation, and analysis of histories of access to and use of information even in cases where users may be anonymous.

Hopefully, the paper will give the reader a sense of the scope, complexity and subtlety of the issues in this area. While perhaps there are a few areas, such as confidentiality of some types of records, on which there is general consensus and which might be addressed quickly, my sense is that it will be necessary to conduct an extensive policy debate with the objective of defining public policy goals before a great deal of progress can be made. In the meantime, to some extent, the best that can be hoped for is that users of electronic information become more aware of the privacy and confidentiality issues involved in their use of electronic information resources so that they can make more informed choices.

Many of the privacy and confidentiality issues discussed in this paper are peculiar in that they can be addressed on two levels: the legislative/policy level and the technological level. The technological solutions are often in turn driven by marketplace perceptions about the value of privacy and confidentiality; if consumers recognize that a serious problem exists and are sufficiently concerned to pay for the implementation of a solution, that solution will often become available. Legislation can, of course, also mandate the implementation of technological solutions, but this is rare. In my view, the technological solutions are often more robust than the legal ones, because the legal

restrictions are very difficult to enforce. Consider as an example the controversy about scanners for cellular telephones, and let us ignore the issues about consumer use of encryption and exportability of products incorporating cryptographic technology touched on elsewhere in this paper. A cellular telephone user concerned about privacy could purchase an encryption device which would provide a high assurance of privacy, at the cost of some inconvenience and subject to the limitation that secure communication would be possible only with other owners of a compatible encryption device. A few cellular phone users did so. Legislation was passed making scanners to eavesdrop on cellular phones illegal; however, such scanners were widely available and it seems likely that anyone who really wants one could still purchase or build one. So, the effect of the legislation has been to provide most cellular phone users (who have not purchased encryption devices) a false sense of security; while cellular phone eavesdropping as a consumer "sport" has no doubt been curtailed, I would suggest that the real problem hasn't been solved. A more effective solution would have been to either establish standards for cellular phone encryption and encourage the marketplace to implement them (and mount a campaign to make sure that users were aware of the risks of purchasing a phone that did not implement encryption) or perhaps even to mandate the inclusion of such encryption devices in new cellular phones.

Very similar problems apply in the case of services that require users to import software onto their personal machines for access, and where that software may collect and export information back to the service in question. While it might be possible to craft legislation to prohibit such practices, this would have to be done very carefully so as not to prevent legitimate and valuable applications. Further, as discussed, the consumer might well be willing to permit export of certain information in return for other considerations such as free or discounted access to services. A better choice here, in my view, would be to combine efforts to inform consumers (including perhaps some sort of labeling disclosure requirement on commercial software that exports information) with investment to develop good technology to permit the consumer to monitor and control the export of information from his or her personal machines. The difference between the cellular telephone example and many of the problems discussed in this paper, however, is that we do not currently have good technological solutions ready to deploy, and thus research investments are likely to be required.

Infrastructure and Standards

There is a tremendous amount that needs to be done to establish a viable infrastructure for electronic information and to ensure that it can become an effective, manageable part of our scholarly and societal record. A good deal of this work is neutral with regard to the public policy questions raised in this paper (although accomplishing these tasks will require that other public policy questions be addressed, such as those related to cryptography). Much of what is needed is simply funding (for research, experimentation and analysis and evaluation of experiments), standards development (discussed in more detail below), authoring and distribution of public domain computer software to help establish a critical mass of implementations in support of selected standards,[91] and to seed the construction of at least some parts of

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91 There are numerous success stories in this area that deserve consideration. Software authored by universities and publicly distributed over the network without cost has led to the deployment of a number of important new network-based information services, such as Gopher. The availability of such software has

the infrastructure that will support networked information; the research and education community and the private sector are already working actively in these areas and are making considerable progress, as Section 2 suggests, but funding sources are few and funding is often a problem. I believe there is reason to be optimistic that some of the legislation currently under consideration will help to address these areas. Leadership in forging partnerships among the research and higher education communities, industry and government is also an important part of the effort required.

A few specific points should be emphasized with regard to the needs for funding. First, funding the infrastructure of the computer-communications network is certainly a prerequisite for the development of networked information, but there is additional infrastructure investment needed over and above that for the web of transmission facilities, switches and other technology necessary to create the communications network itself. This paper has discussed some of the areas in which investment will be needed, such as: systems to support integrity and authentication; systems to permit the location and identification of networked information resources; directories and catalogs to permit network users to find relevant information resources; systems to create, disseminate and view multimedia electronic works. Thus far, the vast majority of the funding invested in encouraging the development of networks at the federal level has gone towards building the communications infrastructure, and, while this investment has been quite successful to date (to the extent that there is serious discussion about when what parts of the communications infrastructure should transition entirely to the private sector) the facilities to support networked information are not nearly as extensive or advanced. The need for federal investment in the networked information infrastructure has not passed, and this should not be overlooked in discussions focused on the need for future federal support for the communications infrastructure.

Also, as a community I do not believe we yet understand how to solve a number of the technical and management problems related to networked information. There is a very real need for funding to support research and experimentation, including the implementation, testing and evaluation of a number of fairly large scale prototypes. The ability to test and learn from multiple approaches will be very important in guiding the development of technology in this area. In addition, we must be sure that there is funding not only for implementation but also for the follow-up evaluations and studies that permit us to really gain the full benefit from pilot projects. Further, there is relatively little basic theory to guide engineering projects in networked information, and much of the research in the field has a very pragmatic, near term focus on developing operational prototypes. A case can be made that this needs to be balanced by funding for more "basic" longer-term research.

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served as a stimulus for additional software development by other institutions as well as widespread implementation of the services themselves. Industry has also made good use of this approach; one notable contribution here is the Wide Area Information Server (WAIS) system developed by Thinking Machines, Apple Computer, Dow Jones and KPMG. Finally, it is important to recognize that many people in the computer networking community believe that the funding that the Defense Advanced Projects Research Agency (DARPA) provided for the incorporation of the TCP/IP protocols into the UNIX operating system at the University of California at Berkeley during the 1980s was a critical factor in the success and explosive growth of both the Internet and the UNIX system.

Finally, this paper has not really discussed where the people will come from who will build and manage the networked information environment; while this is somewhat out of scope for a study of the integrity and access issues in electronic information (other than to point out the obvious, that there will be a need for trained and skilled individuals to manage the information and insure its integrity, and to help information seekers to gain access to it). From the point of view of developing the necessary technology and standards base and actually building the infrastructure, however, there is a developing shortage of people with the necessary combination of expertise. It is necessary for the higher education community to begin now to design and implement appropriate academic programs to develop a large pool of people who can contribute to designing and building the networked information enterprise; some universities have already begun this process, typically building on programs in library and information studies as a starting point. My view is that this is really in some sense a new field, though one that builds extensively on computer science, traditional library and information studies, communications technology, public policy and other disciplines. Funding to support academic research and the development of academic programs to support networked information can thus be viewed as part of the infrastructure investment that will be needed.

There are two particular problem areas impeding the development of the necessary infrastructure. The first, which has been discussed extensively in this paper, is the set of barriers surrounding the large-scale use of cryptographic techniques to implement the authentication and integrity functions that will be essential to the use of electronic information. The impact of these barriers is not limited to electronic information access and integrity; it also poses problems for a number of other network-based applications., including commercial transactions of various kinds. Resolving these problems, I fear, will require nothing less than the development of a rational, clearly articulated national policy on cryptography. There is, in my view, an urgent need for action in this area.

The second problem area is standards. As the paper has illustrated, standards are a key to developing the infrastructure, and also a central part of the strategy for ensuring that electronic information continues to be available in the fact of continual changes and improvements in the technology base used to house and deliver it. Yet the necessary standards are not in place yet in many cases and many of those that have been established are little used in the real world of large-scale, operationally deployed systems and products. Getting the appropriate standards defined, disseminated, and implemented in the marketplace is essential to progress in infrastructure.

There are five major groups of standards-developing organizations functioning today in areas relevant to information technology, electronic information and computer networking:

• International standards bodies, such as the International Organization for Standardization (ISO).

• National standards bodies in the US which link to the formal international organizations, such as the American National Standards Institute and its accredited standards writing bodies (for example, the National Information Standards Organization, NISO, which serves the library, publishing and information services communities).

●The National Institute of Standards and Technology (NIST; formerly the National Bureau of Standards, NBS) which develops standards for the federal government and also is charged to provide leadership in developing standards for the US generally in some situations where progress in standards is critical to US national interests and the private sector is not making sufficient progress.

●A growing array of ac-hoc industry standards development groups, consisting primarily but not exclusively of corporations; these are typically focused on a single problem. Examples include the UNICODE consortium, the Open Software Foundation (OSF), the Object Management Group, and many others.

●The Internet Engineering Task Force (IETF), an informal standards-writing group that manages standards for the Internet and is increasingly also concerned with developing standards to enable and facilitate the use of electronic information resources in the Internet environment.

There are major problems in the standards development system today. A full exploration of these is far outside the scope of this paper; the recent Office of Technology Assessment study Global *Standards: Building Blocks for the Future [U.S.* Congress, 1992], touches on a number of these problems but emphasizes the international perspective and standards in all areas, not just information technology and electronic information. Basically, from the perspective of building the networked information infrastructure, the speed with which formal standards (that is, standards within the ANSI/ISO structure and process) can be developed is too slow, leading to increased reliance on mechanisms like ad-hoc industry groups and the Internet Engineering Task Force. The costs for developing all types of standards have become very high; these high costs are largely precluding the effective participation of many of the communities involved in networked information in the standards development process. The refusal of the formal standards bodies to make their products available at reasonable cost and in electronic form has increasingly limited the usefulness of these products., particularly in disciplines like computer networking; by contrast, the IETF, which makes all of its work publicly available on the Internet, is gaining increased acceptance as a standards developer in many quarters, even though it is outside of the formal standards establishment. Finally, there is a growing perception among many of the people actually involved in building networks and the networked information infrastructure that the formal standards establishment has lost touch with engineering reality; the standards being developed by these groups are not being implemented in the marketplace and existing marketplace standards are not being reflected in the work of the formal standards bodies.[92] To some extent, at least, this problem is being created by conflicts between international demands, politics and commitments, and the policies of other nations regarding technology, standards, and the development of

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92 This problem is perhaps most evident in the **controversies surrounding the two** competing networking standards suites: TCP/IP, which is the protocol that forms the basis of the Internet and is managed by the IETF, and is *not* a formal international standard, and the Open System Interconnection (0S1) protocol suite, which is a large and complex (and not yet complete) set of formal international networking standards that have been under development for about 15 years, but still have not gained large scale marketplace acceptance, despite attempts by various governments (including the US Government) to mandate their use. The history of this controversy is extremely complex and involves a number of political and economic **as** well as technical factors.