

Intellectual Property Rights For Digital Library And Hypertext Publishing Systems: An Analysis of Xanadu

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ABSTRACT

Copyright law is being applied to works in digital form. The special character of digital media will inevitably require some adjustments in the copyright model if digital libraries and hypertext publishing environments are to become as commercially viable as the print industries have been. An intellectual property system works only when it embodies a reasonably accurate model of how people are likely to behave, but it is hard to predict author and reader behavior in an environment that has yet to be built. By far the most ambitious proposal for a digital library and hypertext publishing environment is Ted Nelson's Xanadu system. This paper reviews the intellectual property scheme in Xanadu and contrasts it with current copyright law. Xanadu's predictions about reader and author behavior are examined in light of how people currently behave in computer conferencing, electronic mail, and similar existing systems. These analyses identify some respects in which intellectual property systems might have to be changed to make digital libraries and hypertext publishing systems viable.

INTRODUCTION

An intellectual property system works only when it embodies a reasonably accurate model of how people are likely to behave. Copyright law is based on a relatively simple and straightforward model of author and reader behavior. Authors are assumed to be motivated to produce interesting and valuable texts, and to make these works available to others by copyright's reassurance that authors can control the sale of copies of their works. Readers are motivated to purchase the texts, or to urge institutions, such as libraries, to purchase the texts, so that they can have access to the work. Authors have generally had little control over what uses readers make of the copies after the first sale of the work to the public, and U.S. copyright law has sometimes regarded this lack of control over uses as a virtue. But while it can be said that the absence of use control promotes the dissemination of knowledge, the truth may be that in the print world it is infeasible to maintain meaningful control over uses anyway.

Copyright should be accounted a great success at modeling author and reader behavior, for the basic framework of this law has lasted nearly three hundred years. During this period, copyright industries have flourished and copyright law has broadened to include a wide variety of intellectual products besides those manufactured by printing presses.

Computers and the concomitant capability they have provided for making copyrighted texts available in digital form have created many new and exciting opportunities,

including the potential to create digital libraries and hypertext publishing systems. Active development of such systems is now underway ([Arms90]; [Enge90]; [Kahn88]; [Neuw90]). While there are many difficult technical problems that must be solved to build these systems, they are thought to be surmountable. Less clear, however, is what kind of intellectual property scheme is needed to make digital library or hypertext publishing systems commercially viable. While the copyright model is still being utilized for all manner of texts in digital form, the behavior of authors and readers is being changed by the new digital technologies. It is becoming increasingly likely that some adjustments will have to be made in the copyright model to make digital libraries and hypertext publishing environments as commercially viable as the print industries have been. But few new models have yet been constructed, and work in this direction has only just begun ([Kahn89]; [Zahr89]).

DIGITAL MEDIA AND INTELLECTUAL PROPERTY LAW

Elsewhere the first author has identified six characteristics of works in digital form that seem likely to change significantly the contours of copyright law [Samu90b]. The first and second of these, namely, the ease of replication of works in digital form, and the ease with which such works can be transmitted and accessed by multiple users, will create strong incentives for copyright industries to move away from their traditional focus on the sale of copies, and toward greater control over uses of protected works. That it is now feasible to control uses through controlling access to computer systems containing works in digital form will also affect this trend.

A third characteristic of digital works is the ease with which they can be manipulated and modified. While this plasticity offers users some important advantages over the print medium (printed works are sometimes *too* fixed to be maximally usable), copyright law is more experienced dealing with works that are permanently fixed. The law may need to be adjusted to cope with the new benefits and new problems that this plasticity will entail.

A fourth is that the traditional copyright distinctions among different kinds of works tend to break down when the works are in digital form. Federal copyright law recognizes seven categories of copyrighted works and provides each with different degrees of protection [USC88a]. Is a hypertext version of Mozart's "Magic Flute" that contains the music, the libretto, textual commentary, pictures of Mozart, and other media a "literary work", a "musical work", a "sound recording", a "pictorial work", or an "audiovisual work"? The answer to this question under copyright law cannot be all of the above--even if it is. Copyright's classification scheme, oriented as it is toward the appearance of works, seems in need of adjustment if the statutory differences are absent from the digital representation.

A fifth is that digital works are so compact as to be virtually invisible to user/readers. Consequently, user/readers are more dependent on user interfaces and navigation aids of a sort that the print world has not needed to provide. Intellectual property protection for interfaces and navigation aids are already a source of controversy, both on copyright and patent fronts, and seem likely to be more so in the future. Despite repeated Supreme Court rulings that algorithms are unpatentable [Samu90a] and evidence that practitioners believe strong protection by copyright and patent is bad for the software industry [Samu89], the U.S. Patent Office has been issuing many software patents in recent years. Many of these claim rights to certain functions and user interfaces for hypertext systems (see, for example, [Garb90]).

A sixth characteristic of digital media is the potential they provide for new search and linking activities, which may give rise to new classes of protected intellectual property products.

THE INTELLECTUAL PROPERTY SYSTEM IN XANADU

The most complete proposal for making digital library or hypertext publishing systems commercially viable has come from Ted Nelson, who coined the word "hypertext" and is often--and rightly--perceived as a hypertext visionary. For over two decades Nelson has been writing and talking about a proposed system called Xanadu, a vast digital library containing all of the world's literature [Nels87].¹ Because Xanadu will allow users to create new and derivative documents via links, Xanadu is also a hypertext publishing system. Xanadu can usefully be understood as an attempt to create an institution that will be writing environment, publishing environment, library, and bookstore in one.

Despite his visionary reputation, Nelson is practical enough to realize that the commercial success of the Xanadu proposal critically depends on the way it deals with intellectual property issues. The intellectual property system in Xanadu has sometimes been summarized in writings about the Xanadu system in popular magazines [Fraa87], but has been subject to little serious analysis.

After an introduction to the intellectual property system in Xanadu, this paper will discuss some respects in which the Xanadu proposal differs from the existing copyright system. While Xanadu contains some interesting ideas about how to solve certain problems with digital library and hypertext publishing systems, some aspects of the Xanadu model of author and user behavior may be unworkable. This analysis suggests some respects in which intellectual property systems might have to be changed to make digital libraries and hypertext publishing systems viable.

The Xanadu system builds on the foundation of copyright law, but goes beyond it to include some features that differ significantly from the standard copyright model. Nelson proposes to contract with all authors whose works are stored in the Xanadu system about derivative uses that can be made of documents in the system. Varying the "default setting" of copyright by contract is not, in itself, a novel thing. The motion picture industry is an example of a copyright industry that has historically depended for commercial success on contract-based distributions of copies, rather than on the outright sale of copies which has typified most copyright industries. Nelson's scheme is novel in proposing to use a contract-based scheme for commercial distribution of written texts, the prototypical subject matter of copyright.

Revenue and Royalty Incentives and Mechanisms

Revenues are generated in Xanadu from two sources: one, as author fees for renting space for their documents in the Xanadu system, and two, as user fees for their usage of the system. A portion of the usage fee (estimated at 10-20%) is to go to authors whose documents are accessed by users; the rest will go to the system to recoup costs and make profits. (If public domain documents, such as Shakespeare's plays, are accessed, the author portion of the fee will go into an "author's fund" for scholarships and the like.)

Nelson expects that authors will want to put their documents into the Xanadu system because once the documents are in the system, authors will be able to earn royalties whenever users make use of their documents. For the sake of administrative convenience,

¹Nelson has described Xanadu in numerous publications, presentations, and interviews. Many of the publications have appeared in multiple editions, so it is hard to identify any one work as the definitive specification for Xanadu. Furthermore, Xanadu is being commercialized by Autodesk, a highly profitable firm with a track record of successful products. A commercial version is likely to differ from Nelson's vision, but it is instructive to consider Nelson's proposal in its "pure" form to understand some of the changes and compromises Autodesk is likely to make.

Nelson intends for the usage fees, and consequently the royalties as well, to be set on a per byte delivery basis. Nelson expects that people will pay to use the Xanadu system, because not only will it contain as much of the world's literature as Nelson can get into it, but there will also be legion opportunities in the Xanadu system for users/browsers/readers to make money by adding value to the system through their creative uses of the system.

There are two main ways Nelson intends to let users make money in the Xanadu system. One is by making derivative works of documents already in the system, such as new versions of other authors' documents, compound documents consisting of portions of a number of different documents, or commentaries on other documents in the system. By creating derivative documents, users would become system authors themselves, and thereby become able to earn royalties when other users access their derivative documents. No special permission would be needed to make derivative documents from other authors' documents, for Nelson will make it a condition of storing documents in Xanadu that authors agree to allow others to make whatever derivative uses they want of published documents in the system.

Nelson relies on two factors to motivate authors to agree to allowing derivatives to be made of their documents. One is that they will then be able to do to others' documents what others can do to theirs. But more importantly, when a third party accesses the derivative document on Xanadu, the author of the underlying document, as well as the author of the derivative document, will earn a royalty because the derivative document will be connected to the original document; bytes from both will be called up when third parties access the derivative document. Hence, both authors will receive royalties.

A second way for users to generate revenues when using the Xanadu system will be by creating links between (or among) documents in the system. Nelson expects some links to be very elaborate, such as a specialized index to certain classes of documents in the system; others may be modest, such as a connector between two documents. User links between documents, in effect, become new documents in the system. Each time other users traverse a set of links, the link author will receive a royalty, as will the authors of the documents on either end of the link. Although Vannevar Bush was the first to perceive that information trailblazers would be needed for computerized information systems [Bush45], Nelson deserves credit for recognizing the need to give incentives to information pioneers to cut paths through the invisible contents of a digital library.

Nelson's scheme would also provide authors with the opportunity to store private as well as published documents in the Xanadu system. Authors will be able to define who can have access to the private documents and under what conditions. Private documents can be withdrawn without difficulty from Xanadu by their authors. The same will not be true for published documents because of the effect withdrawal would have on the interests of authors who have linked to or otherwise built upon the foundation of the published document. Nelson attempts to create a strong incentive for authors to publish their documents in the Xanadu system by making system royalties unavailable to authors for private documents, even those with unrestricted distribution (i.e., from which derivatives can be made, and to which links can be constructed). Because publication imposes obligations on the Xanadu operator and the author, publication of a document in the Xanadu system is a formal event, requiring a signature of the author on a form affirming the intent to publish the work.

HOW THE XANADU INTELLECTUAL PROPERTY SYSTEM DIFFERS FROM THE COPYRIGHT SYSTEM

Nelson refers to copyright in a positive way in a number of passages in his book, and takes great care to establish a plausible case that nothing in Xanadu violates existing copyright law. Xanadu gives authors new ways to generate revenues from their works--even some that copyright might not provide--and so aims to create incentives to authorship, revealing a predisposition in keeping with traditional copyright incentives.

But the Xanadu system is more different from copyright than might be apparent from a cursory examination.

Accounting by Uses, not by Copies

One difference between the Xanadu intellectual property system and traditional copyright is that Xanadu aims to derive revenues for authors by charging for each and every *use* of their documents, rather than, as has traditionally been done in copyright industries, on the sale or other commercial distribution of *copies* of copyrighted works. Numerous other commercial computer data bases do much the same thing. Such arrangements seem likely to become increasingly common for works in digital form.

Blurring the "Idea" and "Expression" Distinction and Eliminating the "Fair Use" Provision

More novel are the set of differences from copyright that flow from Xanadu's treatment of links. Fundamental to the copyright regime is a distinction between "ideas" (which are unprotected by copyright) and "expression" (which is what copyright protects). Under the copyright regime, authors generally do not expect remuneration whenever other authors comment on, quote from, use ideas from, or make reference to their work. The "fair use" provision allows even literal copying of copyrighted text if the amount is small and for research, educational, or critical purposes. Only if other authors take a fairly hefty chunk of "expression" from the protected work do copyright holders expect compensation. Even for printed works, however, there is no exact boundary between "small" and "hefty" copying under fair use provisions, and some authors and publishers avoid the issue by obtaining rights to use even a handful of words.

In Xanadu, because information can be included in a document by linking, the definition of what information to count as a single work becomes unclear. This would complicate the determination of what constitutes fair use in any case. Nevertheless, Xanadu allows no fair use copying, and authors in the Xanadu system are expected to get varying royalties based on how many bytes were linked to, merely for being linked to. While Nelson presents arguments for this scheme, an intellectual property system that compensates authors without regard to whether chunks of expression have been appropriated may tend to undermine the "idea/expression" distinction that has been a staple part of the copyright system.

Treating Linking as Authorship

Nelson's decision to treat linking as a kind of authorship--an intellectual activity that should be encouraged, that should serve as the basis for earning royalties when users traverse the links, but that should not be controllable by authors of the documents being linked to--diverges somewhat from the traditional copyright model [Samu90b]. While an extensive set of links, such as an index, might readily be protectable by traditional copyright law as a compilation, many of the kinds of links that Nelson would treat as works of authorship might be unprotectable under traditional copyright law. A link between a passage in document A and a passage in document B might, for example, be considered a "discovery" that the statute says copyright cannot protect [USC88b]. Additionally, traditional copyright law would not regard it as a compensable use of a copyrighted work for readers to traverse the links among documents referred to in a printed article [Samu90b]. Yet link authors in Nelson's scheme would be compensated for link traversal.

Defining "Rights to Do" Rather than "Rights to Exclude"

It seems natural for people to think of intellectual property rights in terms of what authors should be able to get compensation for, what users should be able to do with documents in the system, and the like. This intuitive "rights to do" framework is used by

Xanadu. The law tends to define intellectual property rights in a somewhat different way. The law focuses on what rights owners have to *exclude* other people from doing certain kinds of things with the protected work. (The law, in general, tends to identify certain conduct as prohibited, leaving all else as legal conduct.)

Copyright law defines the ownership rights of authors by saying what kinds of activities they can stop unauthorized people from doing, which chiefly are: making copies of the work, making derivative works, and selling unauthorized copies or derivative works. The only exclusive right Xanadu seems to contemplate is whether or not to put a document into the Xanadu system in the first place. Xanadu is more like a compulsory license system than an exclusive rights system. While U.S. copyright law does contain some compulsory license provisions, compulsory licenses are generally an anathema to owners of intellectual property rights because the license fee generally bears little or no relation to what the market would bear if the issue were left to the market.

Extending the Duration of Rights Indefinitely

The Xanadu system seems to contemplate no end to the duration of author rights. As long as authors (or their heirs) continue to pay for storage on his system, Xanadu will continue to pay royalties for uses of the documents. Copyright must, under the U.S. Constitution, only grant authors exclusive rights for limited times. Upon expiration of the copyright, the work is in the public domain. While Nelson may intend to include this aspect of copyright in the Xanadu system, he makes no mention of it. Certainly, he does not intend to reduce the usage fee for accessing public domain materials; royalties from them go into the "author's fund" over which he undoubtedly will exercise some control.

Making Publication a Formal Event (again)

Publication is an important formal event in the Xanadu system. Under "old" copyright law, an author only "copyrighted" his or her work when the work was published. Since 1976, federal copyright law has protected works of authorship from the moment of their first fixation in a tangible medium. Between 1976 and 1989, publication was mainly important because authors had to attach a copyright notice to published copies of the work. In 1989, this notice requirement was dropped, which made publication into a nonevent in copyright law. By making publication into a significant event, Nelson's scheme resembles "old" copyright more than "new" copyright.

Making publication a formal event in Xanadu is necessary because it creates a contract between the Xanadu operator and the author to guarantee the existence of the published document for a period of time. This provides an integrity to links and citations generally absent in the print world, where only law reviews, with their armies of student citation-checkers, assure the reader that the cited document exists and supports the proposition for which it was cited.

In short, the Xanadu intellectual property system is more different from copyright than one might think from reading Nelson's books. Nelson's insights about linking--the need to create incentives to do it, a willingness to treat linking as authorship and to treat the traversing of links by users as deserving of compensation to link authors, and the inability of authors to control who can link to their documents--are his most important and original contributions to current thought about how intellectual property issues should be handled for digital library and hypertext publishing systems. But some aspects of the Xanadu intellectual property system depend on assumptions about how authors and readers will behave that may be incorrect.

MODELS OF AUTHOR AND READER BEHAVIOR IN EXISTING COMPUTER INFORMATION AND MAIL SYSTEMS

How can one question a model of a system that has yet to be built? Some clues about how authors and readers might behave in digital libraries and hypertext publishing systems come from how people use computer bulletin boards, information services, and electronic mail systems. Instead of viewing these systems as technical precedents, it is instructive to consider them as experiments to develop appropriate models for intellectual property and human behavior to be applied to more ambitious applications like Xanadu.

Prodigy and CompuServe

Prodigy and CompuServe are commercial services that provide a variety of information services, bulletin boards, electronic mail, and entertainment. They embody significantly different intellectual property models and the behavior of their users is markedly different. Prodigy is targeted to the consumer and home market, and treats its users as relatively passive information consumers who do not interact much with each other. Prodigy is marketed in part for its entertainment value, and Prodigy's services are made available for a fixed monthly fee; usage-insensitive pricing is made possible by the paid advertising that Prodigy presents along with nearly every screen of information displayed by users. When Prodigy imposed a usage-pricing scheme for sending electronic mail, many users felt that their contract with Prodigy had been violated.

In contrast, CompuServe is oriented toward business and professional users and has always had usage-based pricing based on connect time. CompuServe information services are specifically focused, organized into a complex hierarchy of bulletin boards and databases, many of which are moderated by an expert, who in some circumstances is compensated by CompuServe. This finer-grained categorization enables CompuServe to impose surcharges for supposedly more timely or valuable information, but its user population is presumably used to paying for information according to its value. Users engage in heated electronic dialogues with each other on bulletin boards, commenting on and criticizing each other's postings.

The Internet

The Internet is a vast network of networks that interconnect thousands of computing sites in government, industry, and academia. The Internet has evolved from primarily providing electronic mail services to become the infrastructure for significantly broader services of information exchange and collaborative work. Like CompuServe, the heart of the Internet is a vast collection of newsgroups in which participants from around the world post and comment on messages. Some people take on the role of newsgroup moderators, but the overwhelming majority of newsgroups are unmoderated.

Author and reader behavior on the Internet are governed by norms or "netiquette" that have evolved over time and that are enforced both by system administrators and by the informal but effective sanctions of "flames" (critical messages) directed at violators. Included in these norms are rules about selecting newsgroups in which to post messages, choosing titles, sensitivity to authors of cited messages, and other topics that improve the lot of both authors and readers.

Users of the Internet vary greatly in their perception of intellectual property laws as they apply to this new kind of publishing system. Some users (especially new users who are college students) act as if the Internet services and the information it contains are completely free, and copyrighted material from newspapers or books often is posted

without permission.² At the same time, other authors explicitly assert copyrights on the messages that they post.

Authors are not paid to publish and receive no royalties, and readers do not have to pay to read, but it is fair to state that these activities are often being paid for (or at least subsidized) by their employers. Hence, it can be argued that anything posted on the Internet that is work-related is the intellectual property of the employer who provides access to the Internet by paying for the computers and telecommunications infrastructure. Employers may feel that the value of the information their employees glean from the Internet outweighs the costs of the time to obtain it, but it is unlikely that few employers explicitly make this analysis.

THE XANADU MODEL OF AUTHOR BEHAVIOR

One fundamental question raised by the Xanadu system is whether authors, particularly good ones, will be willing to pay to publish their works in Xanadu. Some authors may publish documents in Xanadu out of misplaced confidence in the value of their work, just as authors now post messages of dubious information content to CompuServe or Internet newsgroups. They, of course, will get feedback at the end of the first rental period when no royalties are credited to their account. Some authors also seem likely to decide not to renew their document rental space in Xanadu if no one linked to them during the first rental period, even though if they had stayed in the system, their documents would have eventually have been discovered and made them a fortune. Still other authors may lack confidence in their work or may be too poor to afford the rental fee, which may cause them to withhold from the Xanadu system documents that would have been widely utilized if published there. Xanadu might benefit from a scheme by which authors can solicit sponsors willing to subsidize the inclusion of their works in Xanadu in exchange for some portion of the royalties.

Authors may not, in other words, behave in the way Xanadu's designers might expect them to behave. Authors may prefer the print world's system which does not require authors to pay directly for the privilege of being published. Authors may feel it is quite enough to have had to work hard to write the text in the first place. Some of the trick of authoring is writing something that publishers are willing to risk their capital to publish. A system that would make authors pay to get published may end up either deterring authorship or sending authors in search of another digital library/hypertext publishing system in which to place their work.

The Xanadu model may also have underestimated how reluctant many authors may be about giving other people unlimited rights to make derivatives of their work. Although authors seem likely to have no objection to letting Xanadu users link to their documents, they are likely to feel quite differently about allowing any Tom, Dick, or Susan make their own versions of the authors' works, or to combine portions of their documents with portions of others' documents. It will be little consolation to such authors that they too might get royalties when the revised version or compound document was accessed by Xanadu users. Authors often regard their writings as expressions of their personalities. They tend to regard any tampering with their text as a "mutilation" of the work, as objectionable as if someone had the effrontery to walk up to you and cut your hair without your permission. In many countries, authors are expressly granted "moral rights" in their intellectual products, one of which protects the integrity of the work. In the U.S., the derivative work right of copyright owners protects authors' economic interests in controlling adaptations of their works. Nelson, like many members of the computer community, may have a much more positive attitude about taking someone else's work

²These same college students would likely be more sensitive to issues of plagiarism and infringement applicable to printed works when they write term papers.

and building on it to create a better modified version. Nelson seems to have assumed this attitude is more widespread in the authorial community than may, in fact, be true.

THE XANADU MODEL OF USER BEHAVIOR

The Xanadu intellectual property system is also based on a model of user behavior. Nelson has proposed for Xanadu a set of incentives for people to make use of the system for a wide variety of purposes, from research to entertainment to hobby to full-time occupation. Probably his most creative idea is that by which he contemplates transforming the digital library part of Xanadu into a hypertext publishing system, incenting users to become system authors through linking and other derivative uses of documents in the system.

But the royalty mechanism in Xanadu may create some unfortunate, unintended incentives. The system would seem to give an especial premium to those who are first to mention a particular topic in the Xanadu system, even if the first treatment of the topic was shallow or wrong. This may create incentives to rush documents into the system rather than to craft them to be deeper and more accurate.³ An example will illustrate one such problem.

Suppose a journalist attended the first conference of scientists concerning the just-formed Human Genome Initiative, that he was an avid Xanadu user, and that at the first break in the conference schedule, the journalist authored a document for Xanadu describing in a shallow but intelligible way what HGI was about. By virtue of being the first to mention HGI in Xanadu, this journalist's entry might be, for a time at least, the most frequently linked to source on HGI in Xanadu, which would make him the most compensated author on the topic.

A naive user of Xanadu, when faced with a decision to access the journalist's HGI description or a later much deeper one by a scientist who was a founder of the HGI, might see that the first had been linked to a thousand times, whereas the scientist's document had been linked to only five times in the time it was on the system. This might cause the user to choose the more frequently cited source over the better but less frequently cited source, again causing more royalties to flow into the journalist's account, and incenting rushed documents over considered documents in the system. In the print world, the shallow first treatment on a topic will tend to be ignored by later authors, but in Xanadu, the first document to mention a subject might always be called up on a user search, and not until the user reads the shallow document (and hence pays the author royalties on it) will the user know to ignore it. Even creating a derivative document advising users to ignore the underlying document will result in royalties to the author of the underlying document.

Suppose that the journalist's Xanadu document on HGI contained some errors. Other Xanadu users might well notice the errors, and make derivative documents containing the needed corrections. Although this would correct the error, an inadvertent result of the scenario would be that the journalist might make a lot of money from putting out an erroneous document, for every time someone people linked to his document or created a revised version of it, the journalist would share in the revenues. The more, and more noticeable, were the errors in the document, the larger the number of Xanadu users likely to notice the errors, to link to his document, and/or revise it, which once again would

³This phenomenon is well-known in conventional publication media, of course. A visit to a bookstore or grocery store uncovers scores of slipshod books that report on the latest fad, war, movie, or entertainment personality. But Xanadu seems likely to increase the odds that first-in authors are rewarded because it doesn't allow readers to scan the work while waiting in line at the cash register to discover how shallow it really is.

generate more revenues for the journalist. This would seem to over-reward the journalist for rushing to get his document on HGI into the Xanadu system and not deter entry of erroneous information.

Usage-based systems, such as Xanadu, may also have the disadvantage, at least for price-sensitive users, of making those with the most curiosity and tenacity in research to pay the highest cost. They are the ones who will presumably use Xanadu for longer periods of time. Now, one might argue that this is fair because those who use the system the most are those who pay most. But some may conceive the issue differently, and think it one of the great virtues of the library systems of the print world that scholars do not have to pay more than casual users for access to the library. We want to encourage deep scholarship; by not making scholars pay more for their use of the library, the print world encourages scholarship. Digital library and hypertext publishing systems may also need to find ways to encourage good scholarship and curiosity without making it prohibitively expensive.

But a more serious problem perhaps than this may be figuring out how to motivate users to be persistent and creative in their use of the Xanadu system. It is difficult enough for ordinary folk to use libraries with print materials in it which they can walk around and browse through until they find something to interest them. In Xanadu, the clock will be ticking and the price will be rising as one browses. Digital libraries, because of their invisibility to the user, may be, for ordinary folk, too abstract to be enjoyably browsable. Once again, Nelson may have mistakenly modeled the Xanadu user in terms of his own persistence and creativity which others may not share.

QUESTIONS ABOUT PRICING INCENTIVES

But perhaps the single most questionable element of the Xanadu intellectual property scheme, from the standpoint of economic incentives, may be limitations of its pricing scheme. If one looks at the universe of copyrighted works in the print-dominated world, one will immediately observe that copies are priced according, more or less, to what the publisher/distributor and author/creator think the market will bear for the number of copies of it that it is reasonable to think can be sold or licensed. Xanadu posits a flat fee for Xanadu connect time and a fixed royalty for authors based on per byte delivery for certain kinds of usage of the document. This is like mandating that all books must be priced according to the number of pages they contain and all pages must be priced at the same amount. The CompuServe example seems to suggest that differential pricing of information is necessary to encourage the development of specialized markets. Unless Xanadu were the world's only digital library and hypertext publishing system, which remains Nelson's vision but which is unlikely, Xanadu will lack the negotiating power to compel authors to accept fixed pricing per byte of their information.⁴

People who own copyrights in very valuable intellectual properties simply won't use a system that won't let them make market-based pricing decisions. The only options authors of very valuable intellectual properties would have in the world Nelson envisions is to put the work in Xanadu as an encrypted private document and contract with users for access to the document, or to withhold the document from Xanadu altogether. While encryption might allow market pricing to occur, Xanadu does not facilitate these transactions; they are to be dealt with between the parties, but if Xanadu does not facilitate the transactions, it is difficult to see how they can occur. The transaction costs of individual negotiations which must occur outside Xanadu in order to access the

⁴If Xanadu were the only means for authors to publish their works, it would enjoy what economists call a monopsony, a situation with only one buyer for many sellers, which generally leads to exploitation.

encrypted document in Xanadu would seem inordinately high.⁵ Nelson contemplates that authors or publishers of some valuable copyrighted works will choose not to put their documents in Xanadu. Nelson has an answer to this problem that may end up getting him in trouble if it works. Nelson says that it will still be possible for Xanadu users to link to and create derivative documents of works not stored in the Xanadu system. It would not be surprising if a copyright lawsuit was brought to stop such derivative activity.

CONCLUSION

Whether digital library or hypertext publishing systems can be made commercially viable will depend on how they deal with intellectual property rights issues. The traditional copyright model will require adjustments in order to facilitate these new kinds of institutions. Ted Nelson offers one model of how such adjustments might be made. While Nelson's intellectual property scheme for the Xanadu system is bold and innovative, there are a number of respects in which his system can be questioned. Most uncertain are the accuracy of the Xanadu model of author and user behavior, and the adequacy of financial incentives for authors to put their most valuable copyrighted works in the Xanadu system.

A generation of exposure to tape recorders and VCRs, and a raft of new digital technologies for scanning, frame grabbing, and sampling are making it harder to predict how people understand and relate to intellectual property. What is legal, and what is merely technically possible to copy? What constitutes "fair use" of digitally-encoded copyrighted works? Laws that were suited for traditional kinds of copyrighted works no longer seem to fit.

More work is needed to develop new models of author and user behavior and the economics that will yield the right level of incentives for creation of digital library and hypertext publishing systems. The law can be made to conform to these new models, but only after we figure out what the right ones are.

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⁵ Similar complaints about transaction costs for licensing of rights for digital media are motivating the development of new copyright collectives for electronic works modeled after ASCAP and BMI for the music industry [Benn91].

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