The ACM Electronic Publishing Plan

by Peter J. Denning and Bernard Rous

For the past three years, the ACM Publications Board has been developing its vision for the future of publication in the electronic age and a program to achieve it. I am pleased to present that plan here. We envision a diminishing role for print journals and exciting new programs around an ACM digital library. The plan raises important policy questions regarding the treatment of copyright. Our interim answers to these policy questions are discussed in two additional documents—the ACM Interim Copyright Policies and the ACM Author's Guide to the Interim Copyright Policies. Our overall intention is to move aggressively into electronic Publishing and to preserve the traditional openness of ACM publications in the new media. Authors and readers should find these policies at least as hospitable as the traditional ones.

These documents have undergone many rounds of review and revisions, not only by the Publications Board, but by the SIG Board, the other boards, and the ACM Council. The copyright policy alone underwent eight drafts since June 1994 and the author's guide was written after a discussion with the SIG chairs. Even with all this scrutiny, the Publications Board has labeled these as interim policies because it wants to review them in a year in light of experience. Electronic copies of all three documents are available from (acm.org); just point your Internet browser there and go to the publications page.

I would like to thank the Publications Board, editors-in-chief, SIG Board, SIG chairs, and SIG newsletter editors for their help in formulating and debating these documents. I am especially grateful to William Arms and Gio Wiederhold for their hands-on assistance with the copyright policies document, to David Wise for hands-on assistance with the author's guide, and to Mark Mandelbaum for ubiquitous help and guidance in all aspects of the program.

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Publishing has reached an historic divide. Ubiquitous networks, storage servers, printers, and document and graphics software are transforming the world from one in which only a few publishing houses print and disseminate works, to one in which any individual can print or offer for dissemination any work at low cost and in short order. This poses major challenges for publishers of scientific works and for the standard practices of scientific peer review.

The ACM aims to be one of the first scientific society publishers to cross the divide. ACM has embarked on an ambitious electronic publication plan. The plan and the reasons for adopting it are set forth here.

The ACM is the first scientific and educational society formed in the computing field (founded 1947). From the very beginning it entered scientific publishing by establishing the monthly *Communications of ACM* and a peer review process for accepting papers into it. Over the years, its library of traditional journal-type publications has grown to the present size of 17 periodicals including the one monthly, several bimonthly, and the rest quarterly. Its 79,000 members hold 55,000 subscriptions to its journals and nonmembers hold another 13,000 subscriptions.

In the 1960s, ACM established a series of special interest groups (SIGs) that started issuing informal newsletters of their own and began to hold conferences and symposia that published proceedings. Over time, this grew into' a large enterprise, featuring 90,000 memberships in 39 SIGs that sponsor 45 conferences per year and print 17,000 pages of proceedings. All told, ACM literature is growing at the rate of approximately 1 GB per year. The publications of the traditional journals and SIGs constitute a large enterprise, on the order of a third of ACM's $30-million budget.

The Scientific Publishing Tradition

The scientific publishing tradition is a collection of practices and assumptions that have become part of the values and common sense of science. A central tenet of this tradition is publication only after careful and deliberative review by experts. Not only is it considered wasteful to publish a paper that contains errors or repeats earlier work, it is an affront to the tradition of science to publish statements easily refuted by experts. Another tenet is that every published paper is a permanent member of the library of all scientific literature. Many of the scientific societies established their own publishing houses and established review processes; through their membership, they have access to the expert reviewers and

they have a ready-made audience of readers. The societies ensure that repositories exist containing back issues of their publications.

In this tradition, a journal paper passes through four phases, separated by three key moments of public declaration:

Preparation: author drafts preliminary version with early results and obtains informal review by close colleagues. This phase ends with the submission of manuscript to an editor with a request to review and publish it.
Review and revision: editor commissions reviews from several experts, called "referees," and, based on their advice, either rejects or requests revisions from the author. This phase ends with the editor accepting the paper.
Publication processing: editor sends manuscript to publication office for copyediting, layout, queuing, and printing. This phase ends with the actual publication of the paper in a journal and its dissemination to subscribers.
Archiving and indexing: societies and libraries preserve back issues; libraries catalog papers; abstracting services summarize recent papers; citation services accumulate citation indices. Students and other readers use these services to locate works long after they were published.

The second and third phases typically take 6–18 months each, or a total time from submission to publication of 12–36 months. The fourth phase is ongoing. The phases are separated by three key public declarations:

Submission: author declares the paper submitted to an editor; this is documented by a letter to the editor.
Acceptance: editor declares the paper accepted; this is documented by a letter to the author.
Publication: publishing house prints and distributes the copies of the journal issue in which the paper appears.

A copyright transfer usually takes place as part of acceptance. The author grants the publisher the right to use the work in any form for any educational or scientific purpose of the publisher's parent scientific society and retains rights for patents and reuse of the work.

The system relies heavily on the will of the society to continue the journals by marketing and managing subscriptions, setting standards, and appointing new editors. This system also relies heavily on the volunteer efforts of experts and editors. Most of the editorships are volunteer positions; most societies form search committees to locate new editors-in-chief and delegate to the editor-in-chief the authority to appoint associate editors. The reviewers are almost always volunteers; it is the common sense of the field that an author who submits a paper "owes the field" three reviews. In practice, many reviewers report that they receive an average of one manuscript a month for review and that it takes them 2 to 6 months to complete a given review.

Most publishers follow three additional policies. One is a *novel submission* policy, under which an author is expected to submit substantially new material that does not overlap significantly with previous submissions by that or any other author. Second is a *no scooping* policy, under which an author has no authority to distribute copies publicly until the paper has actually been printed. Third is a *proper citations* policy, under which an author is expected to give proper credit to all other persons who contributed to the work in some way, either through previous publication or through private communications. Authors who violate these policies typically receive reprimands from editors and may jeopardize their future right to publish with those journals.

These policies and practices collectively serve to provide an *imprint* or imprimatur to the novelty and soundness of published scientific works. The society gains prestige in the science community by seeking to publish only the most novel, significant, readable, and well-grounded works. The authors gain prestige in the science community by having their works published in prestigious journals. The imprints of a society can be of significant professional value to an author—for example, academic authors consider them essential to promotion and tenure. The harder it is to achieve the imprint and the higher the quality it signifies, the greater its value to an author.

Although less visible, the policies and practices of archiving and indexing are as critical as publishing. A society's imprint would be worthless without reasonable assurances that the published work will be preserved for posterity and that readers can locate the work without having to locate the author. Authors who argue the publishing process ends with publication are forgetting the importance of archiving to the preservation of their work.

Breakdowns in the Traditional System

The traditional scientific publishing system is now facing a variety of breakdowns that must be overcome if the system is to survive. We assume that resolving these breakdowns is preferable to abandoning scientific publishing. From ACM's perspective, the breakdowns are:

1. Most of our journals are written by experts for other experts, but these experts constitute less than 20% of the readership. The other 80%, who are typically experts from other subdisciplines or are practitioners, may be interested in the results but do not have the time or background to understand

the specialized language of the journal's domain experts. These 80% are showing their growing dissatisfaction with the enterprise by complaining about too many esoteric papers, dropping their subscriptions and sometimes their memberships, and demanding new kinds of publications they find more approachable. With the increasing penetration of computers into every-day practices of society, this group is growing. In ACM we refer to the traditional line of publications, which are the majority of our journals, as "Track 1." We are gradually introducing a new line of publications aimed at the other readers; we call these the "Track 2" publications. Among other things, the Track 2 publications can bridge between practitioners and research scholars.

2. Authors are increasingly dissatisfied with delays in the process. It often takes 6–18 months to complete the review-revise phase, and another 12–18 months after that until actual publication. Even if we could magically remove the publication delay by clever use of advanced technology, authors would still be dissatisfied with the long review time. Moreover, readers are dissatisfied if they believe a result known 1–3 years ago has taken this long to be published.

3. It is an increasingly popular practice among authors to post their manuscripts on publicly accessible file transfer protocol (FTP) servers at or before the moment of submission, thus making the moment of publication precede the moment of acceptance. This practice, sometimes called "circulating preprints," not only accelerates the dissemination of new results, it is seen by many as improving the quality of works by subjecting them to wider scrutiny than that of a few referees. This obviously poses a challenge to the policy of not considering previously published works.

4. New questions are arising about who owns (or should own) the copyrights. Since the FTP server is becoming the author's means of dissemination (at least to a core group of interested persons), some authors now wonder whether there is any value in signing over the right to disseminate to a publisher—and some openly wonder if there is any need for the publisher at all. Other authors are looking to publishers to be their agents in bringing their work to the widest audience, and protecting and preserving their work. Artists, following their standard practice, often retain copyright to their art images, and only give permission to include those images in specific papers; this challenges the policy that the publisher may freely distribute copies of the entire paper and complicates electronic redistribution.

5. Libraries are suffering under reductions of their budgets at a time when subscription prices have been rising faster than inflation and the number of scientific journals has been growing rapidly. They are dropping journal subscriptions and joining together in consortia that share one subscription among several institutions. They do not save all published journals; they look instead to the professional societies to do that. This threatens the archiving function by removing the commitment to retain all works indefinitely. It is highly likely that many scientific works exist as citations only (the original documents have been lost), and that many others have been lost completely.

6. The relentless rise of the number of printed journal papers and their prices, and in the number of manuscripts distributed by electronic means, is causing *information overload*. Individuals and institutions alike are shifting from a mode of acquiring publications for just-in-case use to a mode of acquiring them just-in-time. The latter mode is increasingly facilitated by on-line reference databases and document delivery services. This trend, which appears irreversible, will eventually lead to the disintegration of print journals as preselected collections of worthy papers.

7. Although publishers say it is not in their mission to cater to academic concerns for recognition, tenure, and promotion, these concerns nonetheless have been a powerful engine in the scientific publishing industry. Authors tend to submit to journals with the highest perceived prestige. Tenure committees are beginning to assess the value of the imprint rather than the print journal itself. Submissions to traditional journals continue to *increase* even as readership decreases, leading to what some are starting to call "write-only journals."

8. Authors are increasingly viewing their works as "living on the Web," an allusion to the rapidly growing World-Wide Web (WWW) of inter-connected documents. They see networks as new opportunities for collaborative authoring and for dynamic documents that incorporate other documents by link rather than by direct copying. Over time, authors want to introduce either new versions or changes into their own works. This is raising new problems of version control, copy-on-demand when exercising a link, reference, citation, and copyright of a non-fixed work.

9. Authors of works stored on the Web increasingly use active hyper-text links to other works rather than the traditional citation. Clicking on the link invokes a process that copies the referenced work form a remote site. Such a link, when used, becomes a way of incorporating another work on demand into a document. Linkuse is not contemplated in existing copyright policy.

10. Some authors are posting complete collections of their personal works on servers where others can locate them easily simply by knowing the author's name.

In effect, the three key moments of the traditional process—submission, acceptance, and publication—are no longer distinct or in traditional order. The moment of publication is, with the help of public servers, increasingly likely to precede the moment of submission. The moment of acceptance is becoming the moment of imprimatur. Printed publication is becoming less important to authors. The responsibility for archiving and indexing is gradually being abandoned by librarians, who cannot afford comprehensive collections of the software tools for electronic archives.

ACM's Response as a Society Publisher

These breakdowns, and the other changes in means of publication and distribution, show the scientific publishing enterprise is being transformed. The broad outlines of what will emerge are already discernible in the practices of some publishers and in the visions many are expressing of the future. These outlines are centered around a structured database containing the society's published works.

- Journals will become *streams* flowing into the society's database and will retain their identities as *database categories*; at the moment of acceptance, a paper will be placed in the database rather than into a print queue at the publication house. Separate issues and page limits will disappear.
- Societies will offer facilities and mechanisms whereby authors can post collections of their works and obtain public comment on early versions of them. Individuals will cease to purchase journal subscriptions and will instead purchase a right of access to the entire database. They will post interest-profiles and will be automatically notified when new items matching their profiles are posted. They will read from the database and will be responsible for their own printing. The publisher may provide print copies on demand or by fax for a fee.
- Publishers will distribute *notices of availability* rather than journals or documents; readers will locate and obtain copies on demand using new software tools. Local agents specializing in print-on-demand will be established in print shops, copy shops, and libraries, especially at universities.
- New kinds of services such as search, extract, and repackaging will be made available.
- New kinds of works including hypertext, picture, graphics, sound, and other multimedia effects will be sought and accommodated. New paradigms of works such as training packages will also be accommodated.
- All interactions between author and editor, and between editor and reviewer, will be conducted by networked services. This will include all coordination concerning reviews and revisions.
- The publishers will cooperate in *virtual libraries*, offering combined access to library patrons. Thus a member of ACM may also have access to works stored by IEEE.
- Site licenses granting access to the database will become common because they will be cheaper and more convenient than permissions for individual documents.
- Copyright release fees will become nominal and will be collected by automatic meters when documents are extracted from the database.
- Advertising services will become more attuned to individual interests and concerns. Links will be established between literature and related products.
- The society's database will also contain non-archival items such as calendars of events, conference schedules, employment opportunities, and industry news.
- Access to the society's database and its basic services will be the core of the membership package. These transformations have already begun. The clock cannot be turned back. ACM authors are already placing documents in databases on the "web" of information servers. ACM has developed enough of a conceptual framework to position itself boldly in the new world whose general outlines are described here. ACM is undertaking to reinvent itself as a publisher.

In response to the shifting digital media and networks, and to the breakdowns enumerated above, the ACM has embarked on a four-part strategy:

1. Move aggressively toward having the entire ACM literature in an on-line digital library. The service capable of supporting capture and production of works should be available by second quarter 1995 and general dissemination within a year thereafter.

2. Ameliorate the problems of Track 1 Transactions by various delay-reducing improvements. Eliminate processing delay by publishing in the digital library. Be prepared to phase out print versions and phase in electronic distributions.

3. Establish a new line of publication offerings (Track 2) for those devoted to using and applying technology. those who seek more general information about current technical developments, and those who seek to understand current research.

4. Engage in many experiments with new forms of publishing and publication services. Add the best of these to the rep-

ertoire of digital library services. Revise copyright policies to encourage and accommodate the changes fostered by these experiments. (These strategies are briefly described later.)

Although it is not part of the Publications Plan, the ACM has also made it a top priority to encourage and develop an ACM electronic community, supported by a variety of networked services administered through the Internet host acm.org. All the individuals who volunteer services to the profession through ACM are now using the email and bulletin board facilities of Internet to coordinate their actions. Members who do not have Internet accounts can purchase one from ACM at a nominal monthly fee ($12). The new ACM publication structures will exploit the ACM networked services heavily.

ACM Digital Library

The core technology of the ACM approach is a database that serves as an on-line library of ACM's entire literature and offers a range of useful services for electronic publication. It is being developed in two phases. Phase 1 is an initial database and tools to use it for production of publications; this database will come on line and begin accumulating contents in spring 1995. At that time, all new submissions will be in digital form and the system will support capturing, storing, and linking certain non-textual objects such as pictures, graphs, equations, sound, or movies. Documents will be stored in several formats, including SGML, that will permit all their component objects to be recognized during searches.

Phase 2 is the deployment of distribution and access services; it includes establishing a network of servers of ACM materials, installing authentication and payment services, developing search and retrieval services, and interfacing with intelligent agent services. In populating the database of Phase 2, ACM plans that works published after 1994 will be stored in full digital format (original and SGML files, and possibly PostScript, PDF, and Lectern format files). Works published before that will be captured whenever possible in digital format, and most works before 1990 will only be available as text images. The database and distribution services are being designed around these assumptions:

- Electronic documents whose contents are logically structured for search and retrieval will be preferred to electronic analogs of the printed page.
- Visualization of scientific data through multimedia presentations will supplement and enhance text-only documents.
- Documents will be object-oriented, with some components being other objects already published on the Web.
- Not all documents will be read-only; some will be interactive.
- Documents will be sought as needed by readers; hence easy access, high availability, and good performance are essential.
- Access from home, work, or school desktops from around the world will become a primary mode of acquiring knowledge. Good network access is essential.
- Tools to help avoid information overload will acquire central prominence. These will include personal information agents to assist users in selection, filtering; and interpretation. They will include standard interfaces to distributed collections of scientific information from many societies, and will replace the current eclectic set of Internet tools and protocols. Societies will continue to serve domain and discipline needs.

We have made it a high priority to develop authentication services which will be needed to control access to the database and its functions. We will implement new functions, notably access licenses for institutions, short term licenses for non-members, promotional licenses, and triggered functions such as intelligent agents that collect copyright release fees from nonmembers accessing ACM copyright works.

Track 1 Publications

Our short-term objectives are that all print journals and Transactions be published on their schedules; that some be expanded from quarterly to bimonthly publications when the backlog and subscribership would support the increased capacity; that joint journals in overlapping interest areas be established with other societies, for example, the *Transactions on Networks* with IEEE; that specialized journals of other publishers be offered at good prices to our members, for example, the *Multimedia Systems* journal of Springer-Verlag.

Our long-term objective is to transition all our journals to on-line distribution. A number of benefits arise from this: articles are available sooner, costs of printing and binding can be shifted to local sites where they become optional, postage and warehousing costs can be eliminated, individuals can gain access to articles without subscribing to a whole journal, and preliminary versions of papers can be posted for public comment. Print versions will be phased out as the demand for them becomes too small, an outcome that may happen for some journals as early as 1998. We do not expect that print versions of Track 1 publications will be a major source of revenue for ACM in the long term.

We are also undertaking experiments in electronic distribution. In 1995, a new on-line electronic journal of combinatorial and numerical algorithms will begin operation; it will include the current Collective Algorithms (CALGO). Subscribers to *Transactions on Database Systems* (TODS) will be offered on-line access to the queue of TODS papers that have not yet been published. Subscribers to *Transactions on Programming Languages and Systems* (TOPLAS) will be offered on-line access to appendices of published papers, which can then be printed in a shorter form. Conference proceedings will be distributed on CD-ROM—Multimedia '93 and '94 and Supercomputing '94 are early examples. Back volumes of journals will be offered on CD-ROM.

Track 2 Publications

Many ACM members have expressed concerns for learning and effectively using the best new results of technology. ACM has responded to these concerns by repositioning the *Communications*, by undertaking a new Line of Track 2 publications, and by cooperating with some commercial publishers on offerings for our members' Track 2 interests. ACM started two new Track 2 publications in 1994: *Standard View*, a magazine devoted to the debates and controversies in the field of standards; and *interactions*, a magazine devoted to exploring and elucidating new and varied ways computing can reach the world.

We expect print versions of Track 2 publications, including those on CD-ROM, to be a viable business: not only is the market for them wider, but their preparation tends to be sufficiently expensive and time-consuming that most authors will seek professional help for their production and will expect income from their use.

Track 2 is not just a type of publication, it is a way of thinking about engaging researchers, developers, and practitioners together in the ongoing professional learning process. It is a new way of generating offers for members. Other parts of ACM, such as SIGs and education, are also considering new, Track 2 programs.

Experiments

Experimentation with new practices is the only way to find out which ones will be effective. Accordingly, we encourage experiments in electronic publication and seek to facilitate them with new copyright policies. Here is a partial list of the experiments that are underway or will be undertaken soon:

- On-line journal of algorithms (including combinatorics and CALGO)
- Subscriber access to backlog queue of TODS
- Publishing TOPLAS appendices on-line, thereby shortening print papers
- On-line payment and authentication systems
- Local(e.g., campus) distribution in return for digitizing past literature
- SIG conference proceedings on CD-ROM or server.
- Back issues of journals on CD-ROM
- Participation in Stanford NSF/ARPA/NASA-sponsored digital libraries project
- Participation in *Journal of Universal Computer Science* (JUCS), a multi-national publication venture on the WWW
- Cooperation with MIT Press in distributing *Chicago Journal of Theoretical Computer Science*
- Metering use to charge for copyright release
- Local agents (e.g., libraries) for search and print-on-demand
- CD-ROM distribution of images of printed materials in highly readable formats

New Services

The structured database described here positions ACM to offer new services that will make ACM members differentially more competitive than nonmembers. Over time, ACM expects to realize less revenue from print media and Track 1 publications and more from three new principal businesses:

Guided access to literature: Members will be given access to the ACM digital library (and to similar services of cooperating societies) from which they can search and extract documents or summaries. They will be notified of new items that match their interest profiles. Nonmembers can purchase short-term licenses.

Conferences: Conferences will continue to expand. Some of them will be conducted in the Internet. Proceedings will be rapidly available either by network or by CD-ROM.

Continuing education: ACM will offer reading and discussion programs based on collections from the database. Those who pass the quizzes designed with these programs will receive certificates of knowledgeability issued by ACM.

Servers and Links

It is becoming a standard practice among engineers and scientists to post copies of their papers on servers attached to the

Internet and maintained by their employers. These papers can then be accessed from other servers in the Internet and copied by some form of FTP. Readers can attach comments to the posted versions, and authors can post revised copies. Some editors have established moderated preprint comment services to assist authors and to guarantee that no papers or comments can be modified once posted. These practices are widely seen among authors as means to speed the distribution of findings and to improve the quality of papers and algorithms.

A growing number of professional authors and researchers are posting complete libraries of their personal works on servers; they seek protocols hereby the server holding the complete works of any author can easily be located. This is seen by many authors as a way of establishing a network identity and making their works more readily available to anyone who wants them.

It is also becoming a standard practice to think of papers as collections of objects (sections, paragraphs, figures, tables, pictures, and the like) rather than simply as texts. The WWW offers the technology of links, allowing authors to embed pointers to, rather than copies of, objects in their works; the reader can click on a link and thereby invoke a process that calls a copy of the object to the local computer.

The new practice of links-use is widely seen by authors as a means to constructing multimedia, nonlinear documents that incorporate by reference relevant works from anywhere in the world. It is also seen as a way to simplify construction of new works that rely on other works: the author of a work does not have to obtain prior permission to include another work since the other work is not actually incorporated at the time of writing. In other words, the link is seen as a citation and a copy of the work is obtained upon an explicit request by the reader.

These new practices are bringing authors and readers into conflict over copyright laws. Authors maintain that links are citations and it is the responsibility of the copyright owner to demand permission when a reader uses the link. Copyright holders maintain the author is, in reality, intending to make a copy available to the reader and must obtain prior permission. Copyright holders are beginning to design authentication servers so that certain people (such as members of a professional society) can get free access as part of their dues while others must pay to gain access; the holder may offer the nonsubscriber a free preview to help that reader decide whether a full copy is worth paying for.

ACM has decided to treat links as citations. ACM encourages wide use of links as citations. Authors will not have to seek prior permission to place links to ACM copyright works in their new documents. A reader who decides to use a link will negotiate access with ACM at the time of link-use, and ACM will provide mechanisms to make this simple. ACM members and authors will not be subject to copyright release fees when fetching from the ACM databases.

The scientific publishers, such as ACM, are examining ways to structure their copyright policies so they can preserve the spirit of the existing copyright laws within the context of new practices for using servers and links. Until people have settled into standard routines with the new practices, authors and readers will have to think carefully about the copyright implications of their actions.

Policy Questions

The experiments and new media are shifting traditional practices, demanding new policies to cover all aspects of the transformed publications processes. The foregoing discussion reveals a number of policy questions that were not contemplated when the existing policies were formulated.

1. Who holds what rights? Do traditional copyright principles apply to digital versions and transmissions? What rights do authors retain? Their employers?

2. What rights do authors and ACM obtain for object-oriented documents, some of whose components are already-existing, published objects referenced by active hypertext links on the Web? What happens when an author obtains permission, but not copyright, for an object belonging to another author? What are the rules for fetching a copy of an object by exercising a link?

3. Does the new, emerging practice of posting submitted manuscripts on public servers constitute publication? Under what circumstances should ACM retain its no scooping policy? What about its novel submission policy?

4. What notices should authors of submitted papers be required to include with their public-server postings? How should an author's personal copies be treated after copyright is transferred to ACM?

5. Should changes and corrections create new versions of a work rather than replacing old versions? Will articles become more like software, requiring management by version control systems?

6. Should high quality conferences with outstanding reputations be considered of equivalent quality to Transactions and journals? (Conferences review for accept or reject under strict deadlines while journals review for revisions that will improve a manuscript; do these differences matter?)

7. Should there be an archiving fee, replacing the current practice of page charges? Should uncited items be deleted from the archive after a minimum holding time? Should highly cited items be guaranteed a permanent place in the archive?

Answers to these questions are evolving as the field changes and we learn more.

Publishers that learn to provide well structured knowledge through digital libraries and easy-to-use tools will be the main survivors and successful entrepreneurs in the new medium. They will need to develop new policies consistent with their evolving practices and their long-term vision.

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