2005

DOIs and Deeplinked E-Reserves: Innovative Links for the Future

Scott A. Warren, *Syracuse University*

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ABSTRACT. Digital Object Identifiers (DOIs) have uses beyond reference linking and document identification, which are their current primary selling points. Due to their inherent stability, DOIs are well suited for creating deeplinked e-reserves. This paper outlines reasons why libraries should use DOIs whenever possible in the construction of deeplinked e-reserves and provides examples of how such linking can take place, including means for providing security and authentication. Other innovative uses for DOIs in academic libraries are suggested.

KEYWORDS. DOI, digital object identifier, CrossRef, deeplinking, e-reserves, digital libraries

INTRODUCTION

Browse the academic library literature and you will find that OpenURLs, SFX, and other reference-linking software dominate the discussion of

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Scott A. Warren is Librarian, Physical and Mathematical Sciences, North Carolina State University Libraries, Research and Information Services, Box 7111, Raleigh, NC 27695-7111 (Web page: http://www.lib.ncsu.edu/risd/staff/warren or E-mail: scott_warren@ncsu.edu). He holds an MA in Library and Information Studies from The University of Wisconsin-Madison and BSs in Physics, Mathematics, and Astronomy and a BA in History from The Pennsylvania State University.

The author wishes to thank Tripp Reade, the NCSU Libraries' Media Resources Librarian, for starting his interest in reserves and deeplinking.

Technical Services Quarterly, Vol. 22(4) 2005
http://www.haworthpress.com/web/TSQ

Digital Object Identifier: 10.1300/J124v22n04_01

current linking trends and technology. The excitement is justified–SFX really is a marvel and OpenURLs are capable of preventing much patron frustration. The appropriate copy problem has been neatly solved, at least to an extent unimagined even a few years ago. Lurking in the penumbra cast by the bright light of OpenURLs, however, is the slightly older and simpler technology of DOIs and the CrossRef initiative.

While both DOIs and OpenURLs deal with "frameworks in which the four information-gathering demand-side activities (discover, locate, request, and access) can interoperate in increasingly end-user driven environments" (Vogt, 2003, April, p. 25), much confusion exists on the differences between the two and their possible applications within academic libraries. An erroneous assumption is that OpenURLs have somehow supplanted DOIs or rendered them obsolete. Another is "that OpenURL and CrossRef are competitive endeavors" (Brand, 2001, p. 7). Nothing is farther from the truth; DOIs are metadata assigned to documents by publishers and included in various ways in citations by abstracting and indexing services online. OpenURLs are "simply a syntax for transporting metadata and identifiers within URLs" (Brand, 2001, p. 7). One of the types of metadata that OpenURLs can transport is the DOI. In fact, DOIs can be appended to "normal" or base URLs, which render them very useful for solving certain stability issues, a feature this paper will explore more fully.

It appears that libraries are not focusing on DOI projects as much as OpenURL initiatives–or if they are, they are not publicizing them. Most of the literature on DOIs is merely explanatory in nature, stating what the CrossRef organization is doing or how DOIs are added to documents, with little intimation of how libraries are using DOIs in practice to simplify document discovery and access.

Aside from technical definitions and usage trends, the real disparity between DOIs and OpenURLs is that they do not focus on the same information-gathering activities among those listed by Vogt earlier in this paper. By subscribing to CrossRef, libraries can sign up to use the "CrossRef query resolver that accepts bibliographic metadata [similar to what would be in an OpenURL] and returns the corresponding DOI" (Crossref.org, *Query Spec*, p. 1). Though this function is trumpeted as the primary use for DOIs and CrossRef in libraries, it is not the only way, nor perhaps the best way, that libraries can currently use DOIs. The problem in usage lies in how publishers and others working on digital linking procedures view academic libraries. They pay a lot of atten-

tion to reference transactions and even more to end-users' attempts to locate documents on their own. What is disregarded is the fact that from a student's perspective, an equally important academic library service is the provision of reserve readings.

In a reference setting, users rely on databases or catalogs for discovering academic information, particularly journal articles. After this first step, the process tends to get a little bit messier. Given a citation in an indexing database, OpenURLs and linking software like SFX are very helpful to patrons by resolving what types of access a library might have to that article–though it is important to keep in mind that an OpenURL does *not* guarantee that a library has access to a given article. A different way of stating this idea: OpenURLs are best at locating and accessing materials for which the location or local holding is questionable, doubtful, or tenuous, and one particular version of a document that has been discovered as a citation in a database may be preferred (i.e., it is available online–the appropriate copy issue).

DOIs are not as useful for discovering, locating, or resolving whether a particular version of a document exists in a reference setting, even with the CrossRef resolver system. Furthermore, if a library does not subscribe to the system and push bibliographic data to CrossRef in order to get a DOI returned for an item, these queries cannot be accomplished at all because the document in question must first be viewed to get the DOI. Certainly, regular patrons will not be doing this on their own.

Given that OpenURLs appear more flexible and address the appropriate copy problem better than DOIs do, it may come as a surprise to learn that DOIs are still important to libraries. Yet DOIs have yet to be properly used in the academic library setting. While OpenURLs and SFX excel in the area of reference linking, DOIs are superior to OpenURLs when stability is the highest concern. This is because DOIs retain stability and are uniquely attached to the same document forever; indeed this is their primary reason for existing. This paper elucidates DOIs' most compelling feature: The ability to facilitate accessing a given document repeatedly and demonstrates how libraries might best use that feature.

To take full advantage of DOIs, it makes sense to identify where in an academic library stability is more important than appropriateness. So where does determining whether a collection includes an online version of a journal article lose its importance? Perhaps another way of stating

the same query is: Where in an academic library does the appropriate-copy problem not matter?

DOIs AND E-RESERVES

The answer to this question, as might be suspected, is in the reserves department. To see how DOIs might be used in conjunction with reserve readings, let us compare the processes of finding and accessing articles from a reference point of view and from an e-reserves point of view. SFX and OpenURLs have tremendous potential, but so far all of the discussion about them has revolved around the discovery function that takes place during a reference transaction. In that context, the patron searches a database for literature citations, presumably journal articles. If the patron is a student, it is likely that he or she has no idea that the database in question probably will not contain a full-text version of any given article. Patrons may not even understand that they need to look for a journal or recognize that there is a distinction between the catalog and A & I databases. OpenURLs largely bypass this dilemma by performing the cumbersome catalog searching for the journal title in question *for* the patron and, ideally, depositing him or her neatly in the desired article.

Contrast the previous scenario with what happens in reserves, particularly electronic reserves. Presumably the student has a syllabus that says something like, "Read this article by such and such a date. You'll find it online at the library's reserves." The student learns how to link to the library's e-reserves and then searches on his instructor's name or class. A list of articles appears, grouped and displayed in some fashion depending on the ILS and whether the library uses Blackboard, Docutek, or some other extenuating technology.

In no case does the student have to determine whether the library subscribes to the journal that the article came from or figure how to get to the article from a citation. A second very crucial distinction is that with OpenURLs and reference linking, it is assumed that only one person or maybe a handful of people will be looking for an individual article at a time, and some may want one version, others another. With reserves, the opposite is true: Potentially large numbers of students may be trying to get the same document or the same few documents simultaneously and/or successively. Here again, the name of the game is to provide direct, *stable* access repeatedly, not to discover whether and in which formats a given document might be held by the institution.

In most libraries, electronic reserves are made by copying the article from a print source, scanning it, and then uploading it onto a server and putting a link to that PDF file where the student can access it. When the student clicks on a title link, it opens a PDF that is stored locally, so no interaction occurs with the actual online journal in which the article appeared.

At some institutions, however, library staff do not merely copy articles from print sources, but rather find them through the library's electronic journal collection. In an earlier article (Warren, 2004), I outlined a program for managing the workflow required for large-scale deeplinking into journal articles. The primary rationale for that work is that if a library is paying for an online version of a journal, it is senseless for reserves staff to expend time and effort to create an additional local online copy. If we subscribe to hundreds or even thousands of electronic journals, it makes sense to use them fully. When the workflow for staff is properly configured, deeplinking into electronic journals to produce e-reserves is a much more efficient process for a busy reserves department than finding a paper copy of the journal and then creating the PDF.

Here, of course, is where the stability question comes into play. Links from commercial and society publishers are now fairly stable and unlikely to break on any sort of regular basis. Nevertheless, the overall architecture of a publisher's site could very well change a few months or years into the future. Publishers frequently engage in mergers or buyouts, and suddenly the root URL for a site, www.publisherX.com, no longer exists because Publisher Y owns those journals and wants everyone to know it.

The most reasonable response to this potential imbroglio is not to go back to local scanning and storage, but to employ DOIs on an ever-increasing basis to create long-term stable reserves links. In this fashion, readings that are used semester after semester can be accessed with a minimum of worry about dead links. When the scope of reserves room activity is considered–here at the NCSU Libraries, online reserves (both local and deeplinked) were consulted approximately 400,000 times last year–then the ability to create not just links, but long-term *stable* links to online journal articles is of the greatest import.

To assess the feasibility of employing DOIs, it is necessary to ascertain how readily available they are for journal articles and how easily these can be used with proxy services that restrict a reserve room's readings to authorized students. As a general rule, DOIs are very readily available, especially for scientific content, and are extremely easy to locate and import into the 856 field of a catalog record for an e-reserve

document. This paper presents a case study on how DOIs can be used for deeplinking by reserves departments. Before examining how that can be done, however, a review of what a DOI is and how it works might be useful.

DOI BASICS

As mentioned earlier, DOI stands for Digital Object Identifier. A DOI is "a unique alphanumeric string assigned to a digital object" (Crossref.org, *FastFacts, Info for Publishers*, 2003, p. 1). Publishers who belong to the CrossRef Organization, founded in 2000, assign these alphanumeric strings. The system is intended to function in a similar fashion to ISBNs, ISSNs, and other publishing industry initiatives for document control.

DOIs in practice can vary somewhat in syntax, but every "DOI consists of two parts: a prefix and a suffix. The prefix identifies the publishers, which in turn assign the suffix" [hence the variation in syntax] (Jacso, 2002, p. 30). The first part, the prefix, is a numeric string that is assigned by the CrossRef Organization to member publishers. Examples are 10.1016 (Elsevier) and 10.1023 (Kluwer). The current count for publishers is over 250 (see Jacso, p. 30) with all of the major academic publishers represented. The second part, the suffix, can vary quite a bit. Examples include:

10.1006/jmbi.1998.2354 (Academic Press)

10.1090/S0002-9939-00-05422-8 (American Mathematical Society)

10.1086/301055 (University of Chicago Press)

(All examples taken from Crossref.org, *DOI info and guidelines*, 2003.)

For linking purposes, it does not particularly matter what the suffix looks like. Neither librarians nor patrons need to construct these nor interpret them; the suffixes must simply be unchanging–and available for copying.

In every case, however, one, or most commonly, several URLs are assigned to each individual DOI. This way, when the DOI is registered with the International DOI Foundation (of which CrossRef is a member), the current URL where the electronic document is stored is associ-

ated with that DOI. As that URL changes, the publisher can associate new URLs with the original unchanging DOI. When the DOI, or a URL containing that DOI, is clicked on, it will resolve to whichever URL is currently associated with the DOI's document by the current publisher.

EXAMPLES OF HOW DEEPLINKED DOIs WORK

It is instrumental to look at a few examples of DOIs from some larger publishers and see how readily they can be used in linking. First, imagine that the following article has been requested in an e-reserve: "Collaboration between a technological university library and tenant firms in a technology park in Thailand: New challenges for librarianship in a developing country" by Nongyao Premkamolnetr which appeared in *Asian Libraries* (Vol. 8 no. 12, pp. 451-465). Checking the NCSU catalog, I find that we have an online copy of this journal. When I navigate to that particular article, which is provided via Emerald Fulltext, I first see a page that gives me a choice of PDF or html. On this page, in plain sight beneath the publishing information, is a DOI field with the following number in it: 10.1108/10176749910371284. It is not an active link, just plain text. Copying this number, however, and appending it to the base URL, http://dx.doi.org/, creates a stable DOI link. Clicking on the complete link,

http://dx.doi.org/10.1108/10176749910371284

takes one to the following page,

http://caliban.ingentaselect.com/vl=3357525/cl=16/n2=1/rpsv/cgi-bin/cgi?ini=ref&body=linker&reqdoi=10.1108/10176749910371284

which then gives access to either the PDF or html versions of the article.

By way of contrast, at the original Emerald page for *Asian Libraries*, the PDF or html version of the article could have been selected and would have had a URL of the form,

http://matilde.emeraldinsight.com/vl=2760984/cl=31/nw=1/fm=html/rpsv/cw/mcb/10176748/v8n12/s1/p451

There is nothing wrong with this URL per se, but it extremely dependent on a file and folder structure that could change and also is located on a particular server, *matilde*, at the Emerald site. While the previous URL

was also based on a specific server–*Caliban* at Ingenta–the DOI version has no file and folder structure that can be rearranged, and the base URL is permanent. The DOI part, 10.1108/10176749910371284, consists of the identifier for Emerald, 10.1108, and then the unique string that identifies the journal and the specific article in question. As mentioned above in the summary of DOI architecture, once the publisher assigns the DOI to this document, it will never change, regardless of whether the URL changes.

The other part of the complete deeplinked DOI is the base URL, http://dx.doi.org/. The site http://dx.doi.org is maintained by the Handle System and exists to redirect DOIs and other nontraditional electronic locators to URLs. It takes the supplied DOI and then passes it to the appropriate publisher, identified by the prefix. Once at the publisher's site, the DOI suffix is interpreted and translated into whatever current URL exists for the document/article in question. This URL is then returned to the patron's browser and the article loads.

In fact, the http://dx.doi.org prefix is necessary only because most browsers are not set to interpret the DOI protocol. DOI statements can actually be of the form

DOI: 10.1108/10176749910371284

The initial DOI: is an Internet protocol just like http: or telnet:. But because most current browsers are not able to resolve this protocol, it is necessary to append the dx.doi.org URL with its http://protocol.[1]

In our second example, the DOI is actually embedded in the article itself, not only included in a preface page giving PDF or html choices. In "Structural characterization of a dizinc (II) complex with bridging eta 2-phosphate diesters and internal N-H . . . O-P hydrogen bonding," which appeared in *Dalton Transactions*, 2003, (23), 4385-4386, the DOI appears in a preface page, though not as prominently as in the Emerald example. The DOI does, however, appear in both the PDF and html versions of the article, embedded on the first page of either. Again, it is not an active html element, but merely text that has to be copied. This time the final DOI string looks like,

http://dx.doi.org/10.1039/b312881f

Again, this is an extremely simple location that is neither file-and-folder–nor server-dependent. Contrast it with the URL for the PDF version of the article:

http://pubs.rsc.org/ej/DT/2003/b312881.pdf?&YR=2003&VOLNO=%20&Fp=4385&Ep=4386&JournalCode=DT&Iss=23

When the *Dalton Transactions* DOI is clicked, it resolves to

http://www.rsc.org/Cfmuscat/intermediate_abstract.cfm?FURL=/ej/DT/2003/b312281f.PDF

which is actually the preliminary page offering both html and PDF versions of the article. This finesse allows the end-user to choose the format rather than forcing that choice to be made by the staff member creating the deeplinked e-reserve.

The first two examples, *Asian Libraries* and *Dalton Transactions*, both featured DOIs that were only text appearing somewhere on a page either in the article in question or on a preliminary format choice page. Other publishers, however, have gone beyond offering DOIs as plain text and have enabled them as active html elements on Web pages. This added functionality ensures a much greater ease of capturing and inputting DOIs into deeplinked e-reserve links. For this bonus capability to be featured in the article itself, the article must have an html version. Otherwise the active DOI must appear on a preliminary page such as a format choice page or an issue page.

In an example much closer to home for readers of this journal, *Technical Services Quarterly*, consider the article in vol. 20, no. 4, (6-2003), p. 3-57 by Lona Hoover and Robert E. Wolverton, Jr. entitled "Cataloging and Treatment of Theses, Dissertations, and ETDs." The Haworth Press, Inc., perhaps because it caters to the library community (among others), prominently displays the DOI for each article on the online issue page for the journal and again on the first page of the PDF of each article. The issue page DOI is an active link.

10.1300/J124v20n04_02

Clicking on it takes the viewer to the article; in this case it launches the PDF. Thus all a staff member needs to do to capture this DOI is to right-click the DOI link, select "copy shortcut," and then paste the result into an 856 field of a catalog record for the e-reserve. If you copy the link and then open a new browser and paste it into the location box, the surprise is that the pasted DOI immediately resolves to the URL for the article's location, in this case:

http://www.haworthpress.com/store/E-Text/View_EText.asp?sid=HUV0PDKQENX29JWXKL7T6GJMEVWV0VD0&a=3&s=J124&v=20&i=4&fn=J124v20n04%5F02

Again, this URL is long and messy and prone to change. By pasting the DOI,

10.1300/J124v20n04_02

into an 856 field, however, the DOI does not immediately resolve. Thus the link in the e-reserve is the much more economical

http://dx.doi.org/10.1300/J124v20n04_02

A final example comes from Elsevier's ScienceDirect. "Composition of surface oxide film of titanium with culturing murine fibroblasts L929," by Sachiko Hiromoto, appeared in *Biomaterials* (vol. 25, Iss. 6, March 2004, pp. 979-986). Again, the DOI is on a format choice page and then on the first page of both the html and PDF versions. On the format page and the html version of the article, the DOI is an active link,

Doi: 10.1016/S0142-9612(03)00620-3

Rolling over this link shows the following URL

http://dx.doi.org/10.1016/S0142-9612(03)00620-3

This is also the URL that is pasted when the DOI is right-clicked and "copy shortcut" is selected. Therefore, in this instance, even the initial appending of http://dx.doi.org is unnecessary. When the DOI resolves, the following unwieldy URL appears in the location box,

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6TWB-49M0NRM-2&_coverDate=03%2F31%2F2004&_alid=135988909&_rdoc=1&_fmt=&_orig=search&_qd=1&_cdi=5558&_sort=d&view=c&_acct=C000015398&_version=1&_urlVersion=0&_userid=290868&md5=c3aacc660c7e980d2887467c31ad606f

This monster URL is extremely complicated and apt to change since it is comprised of so many elements.

This ScienceDirect example brings to light some other less obvious advantages offered by using the DOI instead of the regular URL. First, it allows deeplinking in situations where regular URL deeplinking fails. In the ScienceDirect/Elsevier example it is not at all clear that the URL

provided upon first viewing the article in fact contains a session ID–which it does. This means that this URL is immediately rendered useless for purposes of deeplinking. The URL literally is good only for the viewing session. When I investigated creating a program of stable deeplinks for the NCSU Libraries' reserves department, the inability to deeplink in ScienceDirect was a great source of concern since the NCSU community relies heavily on science and engineering journals.

By contrast, DOI-based deeplinks into ScienceDirect and Elsevier journals remain completely stable across multiple viewing sessions. The use of a DOI offers a "back door" into the article. In fact, the five DOI-based deeplinks that I created into five different Elsevier journals as an experiment in March 2002 are still stable and work correctly (as of January 7, 2004). When using the regular URLs provided by Elsevier, however, the links lasted no longer than the viewing session.

Why could this not be done just as well with OpenURLs? Theoretically it could, but it would be far more cumbersome. OpenURLs tend to be very lengthy structures built up with a complicated syntax from an item's bibliographic information. No articles come ready-made with a unique OpenURL attached. Harry Samuels, the digital library projects coordinator for Endeavor, has expressed doubts regarding using OpenURLs for identity purposes:

> I'm skeptical that the OpenURL can ever be as accurate as a DOI. For example, OpenURLs require page numbers, but with electronic-only copy we may no longer have page numbers in the future. OpenURLs are very much based on paper-based publication models for journals. (Vogt, 2003, April, p. 26)

Given their limitations, OpenURLs do not seem particularly well suited for uniquely identifying a particular document and returning to it over and over again.

Furthermore, anyone who has ever used SFX or another linking service knows that a service window pops up between clicking on the OpenURL link and accessing the document (or the issue level). Users are expected to understand how this window is laid out and then make an appropriate choice again, whereas DOIs take the user straight to the article. If the service window is poorly designed, it can amount to a stumbling block for patrons trying to access full-text copies of an article. A system containing this level of complexity risks confusing inexperienced library patrons and is poorly designed for heavy electronic reserves usage.

AUTHENTICATION AND DEEPLINKED DOIs

One final question about deeplinked e-reserves is that of authentication. Because electronic journals generally constitute proprietary content and are limited to student, staff, and faculty use through licensing agreements, deeplinks into them must somehow be secured. One way to do this is via a proxy server. Some libraries require end-users to configure their browser for a proxy connection that then ensures they are authenticated before viewing any material. Wherever that is the case, the DOI statements would mimic those shown in the earlier examples.

Another method is to use proxy services such as EZProxy. With proxy services, all links have a "proxy statement" prefixed to the remote URL. In effect, the patron logs into the local proxy server with a campus ID and then on to the remote resource. Fortunately, this procedure does not in any way complicate using DOIs. For instance, all four of the above examples can be "proxied" for use at the NCSU Libraries' reserves by adding the string,

http://www.lib.ncsu.edu/cgi-bin/proxy.pl?server=

to the beginning of each URL and stripping the initial http://from those URLs. The first DOI example, the Emerald journal, *Asian Libraries*,

http://dx.doi.org/10.1108/10176749910371284

becomes

http://www.lib.ncsu.edu/cgi-bin/proxy.pl?server=
dx.doi.org/10.1108/10176749910371284

The other three examples would be treated in exactly the same fashion. A macro can easily be scripted to place the initial proxy URL prefix in an 856 field at the click of a button rendering the procedure more seamless and less time-consuming for staff.

OTHER USES FOR DOIs

Another potential application for DOIs in an academic library setting is in the creation of bibliographies. Even though millions of articles now have DOIs, they are not mentioned in any of the major style manuals as

a standard and essential piece of metadata to include in article citations. The style manuals recommend the inclusion of a URL (if the article is viewed online without consulting the printed equivalent) but neglect to acknowledge the purpose or importance of DOIs for citations. Adding DOIs to all citations in professional journal literature should be second nature for librarians. Yet it is not, based on a cursory examinations of bibliographies culled from a variety of journals across the field of library and information science.

A more adventuresome use of bibliographies is currently being undertaken at NCSU through a project funded by the National Science Foundation. Dr. Robert Beichert of the NCSU Physics Department and I are collaborating on the creation of a clearinghouse of physics education research materials.[2] In the spring of 2004, a graduate student under my supervision will complete an exhaustive annotated bibliography of that emerging discipline. Owing to copyright restrictions, copies of relevant articles cannot be scanned and added to a local database. Yet, to the greatest extent possible, we would like to ensure that the clearinghouse is not merely a passive bibliography but a tool that actively connects faculty and graduate student users to the documents in question. Thus this bibliography can be construed as a type of "reserve reading list" for future researchers in this field. Much like students locating reserve readings required for a course, members of the physics community looking at lists of documents are likely to want to access those documents immediately.

The easiest way to do this is to provide links to whatever articles the NCSU Libraries subscribe to electronically, but doing so would only provide local access and this project is ultimately intended for researchers anywhere and will not be hosted here. Because the database/clearinghouse is seen as a long-term project, OpenURLs are not necessarily a viable solution for providing a possible link in a citation. As with e-reserves, the best and most stable methodology for deeplinking at present is to use DOIs.

As part of the metadata for each journal article added to an EndNote bibliography, a field will be created for a DOI whenever one is available. This guarantees long-term electronic discovery. When the clearinghouse proceeds beyond the annotation stage toward a fully realized and searchable database, the DOIs can be turned into active links and the clearinghouse becomes a conduit to the materials (depending, of course, on local holdings).

A related, but more hypothetical application that bridges the concepts of reserves and citations may emerge with the creation of institutional repositories such as MIT's D-Space. As libraries contemplate setting up their own repositories–essentially, enormous institution-wide "reserves" collections–one of the more nettlesome challenges is the fact that few of the scholarly publications created by members of a campus community are actually owned by that community in terms of copyright. While compiling and archiving unpublished local material appears to be the main objective of such repositories, scholarly publications can also be included by adding in DOI links in citations for published articles. In this way, a complete publishing record of any researcher can be accomplished.

CONCLUSION

One final and major advantage of using DOIs for deeplinking is the cost of entry for libraries–nothing. Unlike OpenURLs, they are free. "The costs of the CrossRef system are borne by publishers–hence free to the end-user" (Crossref.org, *Info for researchers*, 2004, p. 1). There is no expensive software to purchase and maintain (see Crossref.org, *Library Fees*, 2003). Compare this situation with that of the appropriate copy solutions. Grogg and Ferguson report that all of the major reference linking services have a price that may include a license fee, an annual maintenance charge, or a price based on campus size (2003, p. 26-31). At a minimum, "the typical customer for any of the three links-resolver products may be paying . . . $5,000 . . ." (Vogt, 2003, April, p. 25). As a stability solution for deeplinked e-reserves, DOIs imply zero cost and no entry barriers to participation–meaning that libraries of any size can use this methodology.

The advantages of DOIs for libraries have by no means been rendered obsolete by SFX and OpenURLs. Librarians have been looking in the wrong place–the reference desk–to use DOIs when their greatest utility may be achieved in the reserve room. Libraries should begin using DOIs for online reserves whenever possible due to their impressive record of stability, no-cost usage, widespread availability, and simplicity of embedding in reserve URLs. Likewise, librarians should place DOIs in their own bibliographies whenever possible, and encourage such practices when teaching students citation practices.

As a matter of fact, there is a good chance that DOIs will grow in importance over the next several years rather than being eclipsed by

OpenURLs. "If you've got a DOI, then you *know* the article is there, whereas an OpenURL only *assumes* it's there" (Pesch in Vogt, 2003, April, p. 26). Pesch refers to the four functions described by Vogt: discover, locate, request, and access. DOIs continue to matter because of the question of access. Stability is as important as discovery; reserves are as important as reference. The key for libraries is to apply the most appropriate linking strategy at either service point instead of trying to put the square peg in the round hole.

While this entire article presumes the usage of DOIs for journal articles, the CrossRef organization is, in fact, considering applying DOIs in a variety of other ways. Ed Pentz, CrossRef's executive director, says that the CrossRef Organization has produced

> A paper . . . describing how DOIs can be assigned at the journal level and what the policies will be and conducted end-user surveys . . . trying to find out just what the value proposition of such a full-text service would be *if* [emphasis in the original] we theoretically were able to get all the publishers to provide us with their full-text content for searching purposes. (Vogt, 2003, July/August, p. 48)

Barbara Quint goes a step farther and reports that

> The Publisher's International Linking Association (PILA) announced plans to expand CrossRef (http://www.crossref.org), its master database of links. Instead of linking only from citations to the full-text articles that are available on hundreds of publisher Web sites, PILA has initiated a CrossRef Search Project that could ultimately introduce full-text searching of articles by all participating publishers. (Quint, 2002, p. 8)

She aptly forecasts that "a CrossRef that draws on the full-text of journal articles will ramp up its utility exponentially" (Quint, 2002, p. 8). It seems likely that a few years from now, CrossRef will not just be registering and applying DOIs to journal articles, but also leveraging some new form(s) of technology and actively shaping the discovery and linking of many forms of scholarly information.

Harold Billings, the director of libraries for the University of Texas at Austin speculates, "The CrossRef enterprise represents a powerful commercial alliance that could either help or hinder affordable access to the literature of science, technology, and medicine" (Billings, 2003,

p. 106). One way to ensure that the CrossRef organization continues to support affordable access and the general mission of libraries is for librarians to vivify their use of the DOI in novel ways. If librarians begin to make widespread use of DOIs, for instance, in reserve rooms and bibliographies, we may increase the odds that the CrossRef organization not only continues to work with publishers, but keeps libraries and library users in mind as well.

NOTES

1. A "plug-in was released for Netscape and Internet Explorer in late August [2002] that accepts links in the form of DOI: 10.1015/S0740-8188(98)900016-0 without identifying the server's address, which resolves the DOI. This means that the DOI references can be cut and pasted without the need to add the http://dx.doi.org path in front of them" (Jasco, p. 31). The plug-in is available, along with other similar tools, at http://www.doi.org/tools.html.

2. The professional literature of teaching physics at the undergraduate and graduate levels, which is a relatively new field, dating from the early 1980s.

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Received for review: January 21, 2004
Accepted for publication: February 17, 2004