

Emerging Uses for the OpenURL Framework

Ann Apps and Ross MacIntyre

MIMAS, The University of Manchester
Manchester, M13 9PL, UK
{ann.apps, ross.macintyre}@manchester.ac.uk

Abstract

This paper describes the OpenURL Framework, both the original 'de facto' standard version 0.1, and the NISO standard Z39.88-2004, 'The OpenURL Framework for Context-Sensitive Services'. The explanation is illustrated by examples from Zetoc, a journal article and conference paper current awareness service available in the UK. Various emerging novel uses of the OpenURL Framework are described. Evaluation studies indicate positive reader appreciation of OpenURL technology providing direct access to discovered articles.

1 Introduction

'The OpenURL Framework for Context-Sensitive Services' (NISO, 2005) provides a way to describe a referenced resource, known as the referent, along with other associated resources in the context of that reference. OpenURL Framework applications transport these packages of information, called ContextObjects, over a network generally with the intention of obtaining services pertinent to the referent. The OpenURL Framework, known as OpenURL version 1.0, was developed from OpenURL version 0.1 (Van de Sompel, Hochstenbach & Beit-Arie, 2000), which has become a 'de facto' standard within the scholarly information environment. The OpenURL Framework standard, Z39.88-2004, was endorsed by ANSI NISO (the US National Information Standards Organization) in April 2005. So this seems an opportune time to survey some emerging uses for OpenURL as well as its now established use.

2 Traditional Use of OpenURL

2.1 Linking to Appropriate Copy

The traditional use for OpenURL is to enable a reader of a scholarly work published electronically, such as a journal article or a book, to link relatively seamlessly, seemingly almost magically, from a reference to an 'appropriate' electronic copy of a cited work, that is one to which the reader's institution has a valid subscription or an open access journal. OpenURL links are enabled in various source electronic publishing applications such as electronic journals and 'abstracting and indexing' services.

2.2 OpenURL Resolver

This linking is facilitated by OpenURL resolver software, available from several vendors, deployed by an organisation such as an academic institution. A resolver incorporates a 'knowledge base' that captures an institutional library's subscriptions to electronic journals and other resources, as well as details of how to encode links to a large number of target electronic resources, both traditionally published and open access.

Thus when a resolver receives an OpenURL from a reader who has clicked on a reference link, it can provide that reader with a link to the referenced work if the reader has a right of access. Generally, rather than providing a straight redirect through to an electronic article, a resolver will show to the reader a set of links, including a link to the full text of the article where appropriate. This menu will also contain other links to related items of possible interest, such as an abstract of the article or a search for other works by the same author.

Generally the content of the menu shown to the reader is decided by the library, which also has responsibility for populating the knowledgebase with their holdings information. Typically, it is the software vendor who maintains details of where articles are available and how to link to them.

OpenURL is not a competitor for Digital Object Identifier (DOI) based cross-publisher linking initiatives such as CrossRef, but a complementary technology that enables localised linking at a user's site (CrossRef, 2003). If a resolver receives a DOI for an article it will use it to retrieve bibliographic details about the reference before continuing its usual link provision.

3 Zetoc OpenURL Linking

3.1 The Zetoc Service

Zetoc (Zetoc, 2005) is a current awareness and document delivery service based on the British Library's Electronic Table of Contents data. It provides citation details about articles from 20,000 current journals and papers from 16,000 conferences per year, covering every imaginable subject, data being available from 1993 and updated daily. The service is available within the UK to Higher and Further Education institutions and the National Health Service, to various other UK academic bodies and to Irish colleges. As well as a Web-based search interface, Zetoc provides an email alert service to assist researchers' discovery of new articles within their field. (Figure 1) shows an example Zetoc 'full' record for a journal article such as could be reached either following a search or from a URL in an alert email.

Author(s):	Noakes, C. J.; Fletcher, L. A.; Beggs, C. B.; Sleight, P. A.; Kerr, K. G.
Article Title:	Development of a numerical model to simulate the biological inactivation of airborne microorganisms in the presence of ultraviolet light
Journal Title:	JOURNAL OF AEROSOL SCIENCE
ISSN:	0021-8502
Year:	2004
Volume/Issue:	VOL 35; NUMBER 4
Page(s):	489-507
Dewey Class:	541.34515
LC Class:	QC882
ZETOC ID:	RN147105196

Figure 1. An Example Zetoc Full Record

3.2 Zetoc Document Delivery

Zetoc provides three document delivery options to assist access to the full text of an article. Two of these, purchasing a copy directly from the British Library with a copyright fee included in the price, and requesting a copy through an institution's library, follow traditional models for obtaining copies of articles. The third option, a link to 'More information about this article', provides an OpenURL link to a reader's institution's OpenURL resolver. Utilising this link a reader can get from an email alert to the full text of an article in 3 'clicks', provided their institution has an OpenURL resolver and a subscription to the journal.

3.3 OpenURL Source Links

There are two problems to solve in order to provide seamless linking from an article citation to the full text of an article. Firstly, information about the article must be passed in a format that the servers at each end understand. Increasingly OpenURL is being used as a standard, interoperable format rather than earlier proprietary solutions. (Figure 2) shows the version 0.1 OpenURL that is created by Zetoc for the article of (Figure 1), the citation metadata being passed as a set of 'key=value' pairs as part of a URL query string that will be passed over the Web's Common Gateway interface (CGI). For safe transmission of this OpenURL some characters would have special encodings, but for readability these encodings are not shown in (Figure 2), and some linebreaks have been included. The right hand column provides explanation of some of the keys and is not part of the OpenURL.

<code>http://openurl.ac.uk/athens:man/?</code>	Base URL of resolver
<code>sid=mimas:zetoc</code>	Generated by Zetoc
<code>&genre=article</code>	This is metadata for a journal article
<code>&atitle=Development of a numerical model...</code>	Article title
<code>&title=JOURNAL OF AEROSOL SCIENCE</code>	Journal title
<code>&issn=0021-8502</code>	Journal ISSN
<code>&aulast=Noakes&auinit=C.J.</code>	First author: name, initials
<code>&date=2004&volume=35&issue=4&spage=489&epage=507</code>	Publication details

Figure 2. An Example version 0.1 OpenURL

3.4 OpenURL Resolver Address

The second problem is to know the address of the user's OpenURL resolver to which to send the request. Because Zetoc authenticates users, either by their machine address, or by Athens authentication, it knows their institution. Institutions that have an OpenURL resolver register its address with Zetoc, and this address is used when a reader selects a 'More information' link. Currently the wording of this link is neutral and seen by all Zetoc users, though customisation may be implemented in the future.

For users in UK academia that do not have an OpenURL resolver who are seeking to find journal articles, Zetoc provides a link to MDL LitLink (MIMAS, 2003) as a default resolver. LitLink knows where many articles are available but it cannot provide a link to an 'appropriate copy' because it has no knowledge of a user's subscriptions. On the other hand many institutions have access to the major resources. In order to manage user expectations, the link from Zetoc to LitLink includes the caveat 'it's worth a try, but access can't be guaranteed'.

3.5 Alternative Ways to Determine a Resolver Address

The strategy of registering institution OpenURL resolver addresses is suitable for a service such as Zetoc that authenticates users. But for freely available services a different approach is needed. One possible way is to record the resolver address in a cookie in the user's Web browser maybe after asking the user for their location or resolver's address.

Within the UK, the OpenURL Router service (EDINA, 2005) provides an alternative method. Institutions register their resolver address once only. Source applications send all their OpenURL requests to the OpenURL Router, which determines the user's location from their machine address, or by asking them, and passes on the request. Similarly to Zetoc, the OpenURL Router provides access to default resolvers.

4 The OpenURL Framework

Because of the rapid adoption of the original OpenURL specification, it was developed into the ANSI NISO standard Z39.88-2004, 'The OpenURL Framework for Context-Sensitive Services'. This standard is both a formalisation of version 0.1 and a generalisation to extend its use beyond the scholarly information domain. The standard, commonly known as version 1.0, introduces the notion of a ContextObject that describes a referenced resource, the referent, along with various associated resources in the context of that reference. This context may include the source application, the record within it where the reference is made, the resolver, the requester (i.e. the user) and the type of service requested. Resources may be described by identifiers or by metadata. OpenURL itself is a method of transporting this ContextObject.

The basic components of the OpenURL Framework are defined in the OpenURL Registry (OpenURL, 2005). This registry will be extensible to record information from other domains beyond the scholarly information community, the definitions of community profiles also being registered. The initial registry includes components suitable for use in the scholarly information community: appropriate identifiers; and metadata formats for journals and articles, dissertations, patents, and books, including conference proceedings and papers. The OpenURL Framework is described in more detail in the standard itself and in the 'Key/Encoded Value Format Implementation Guidelines' (NISO AX & Apps, 2004), which contains examples of OpenURLs for scholarly information resources and detailed instructions for upgrading from version 0.1.

Although this development appears initially to be an over-complication of the original simple idea, it is really just an extension of it. The apparently new components were already part of version 0.1 OpenURL, or they were being included by implementers in the private area of the transferred link. The formal inclusion of these new entities opens up new possibilities of use for OpenURLs.

<code>http://openurl.ac.uk/athens:man/?</code>	BaseURL of resolver
<code>url_ver=Z39.88-2004</code>	This is a version 1.0 OpenURL
<code>&url_ctx_fmt=info:ofi/fmt:kev:mtx:ctx</code>	ContextObject with 'key=value' pairs follows
<code>&rft_id=info:sid/mimas.ac.uk:zetoc</code>	Generated by Zetoc (the referrer)
<code>&rft_val_fmt=info:ofi/fmt:kev:mtx:book</code>	Referent is described by book metadata
<code>&rft.genre=proceeding</code>	Referent is a conference paper
<code>&rft.atitle=CABREF: Cross-Referencing into...</code>	Paper title
<code>&rft.btitle= Electronic publishing; 2001</code>	Proceedings title
<code>&rft.isbn=1586031910</code>	
<code>&rft.aulast=Apps&rft.auinit=A.</code>	First author: name, initials
<code>&date=2001&spage=256&epage=265</code>	Publication year and pagination

Figure 3. An Example version 1.0 OpenURL

(Figure 3) shows a version 1.0 OpenURL that would be generated for a conference paper by Zetoc. The significant changes from version 0.1 are the introduction of extra keys and values specifying formats used and the prefixing of keys to define to which entity they apply, 'rft' indicating the referent. Again this example is not URL-encoded, includes some linebreaks for readability, and the additional right hand column provides explanation of some of the keys.

The upgrade transition period poses a problem for referrers, i.e. source applications that generate OpenURLs. It is not possible to know whether a resolver to which an OpenURL is sent has upgraded to version 1.0, which requires both the vendor to upgrade the software and the library to apply that update. To overcome this problem, it has been suggested that referrers generate 'hybrid' OpenURLs that include keys from both version 1.0 and version 0.1 where these differ, resolvers being expected to ignore keys they do not understand.

5 Novel Uses of the OpenURL Framework

Since the development of the OpenURL Framework standard, further uses are starting to appear. The traditional OpenURL carried its metadata description of a referent as a set of 'key and value' pairs on a URL. While this format is still available to describe a ContextObject, as shown in the above examples, the standard also includes an XML serialisation, opening up the possibility of using OpenURL ContextObjects for 'server to server' communication. Version 0.1 of OpenURL defined a domain-restricted set of metadata covering only books, journals and conference proceedings. Whereas the OpenURL Framework defines metadata formats in an extensible registry, potentially extending use to a diverse range of domains.

5.1 Google Scholar OpenURL Linking Prototype

Google Scholar (Google, 2005) has begun to provide OpenURL links from search results that are journal articles that have either Digital Object or PubMed Identifiers. This prototype is available to a small limited number of institutions, but Google Scholar plan to extend this functionality more widely. Experimental OpenURL extensions to Google Scholar that work within the Firefox Web browser are appearing, including Openly Informatics' OpenURL Referrer (Openly, 2005). This allows an individual effectively to customise Google Scholar to include links to their institution's OpenURL resolver, and hence to the full text of articles of interest, alongside results following a search.

5.2 Dublin Core Description of Bibliographic Items

It has long been a problem within the Dublin Core Metadata Initiative (DCMI, 2005) that there is no obvious way to capture the bibliographic citation about a bibliographic work such as a journal article within its own set of metadata. Relatively complicated citation schemes exist for capturing individual elements of a citation, as do schemes for encoding a citation within a text string using punctuation. But whereas the former option is probably over complicated for applications that want to provide Dublin Core metadata descriptions for simple resource discovery, the latter is sufficient for human readability but not for reliable machine reading. Guidelines for encoding bibliographic citation information in Dublin Core Metadata (Apps, 2005), which recommend the use of an OpenURL ContextObject within a Dublin Core 'bibliographicCitation' property (that is a refinement of 'Identifier'), are progressing towards becoming a DCMI recommendation. In the future it is hoped to provide guidance for an XML encoding of bibliographic citation information, based on the XML ContextObject format.

5.3 A Bibliographic Web Services Interface

Zetoc developed a Web Services SOAP interface (Apps, 2004a), initially for use within an e-Science grid project where this is the usual protocol for interaction between services. The data interchange format used by SOAP is XML, requiring an XML encoding of a full Zetoc data record, which includes its bibliographic citation information. It seemed wise to promote interoperability by using properties from open standard namespaces where these exist. Thus journal article bibliographic citation fields in an XML record returned by the Zetoc SOAP service are taken from the OpenURL Framework's XML journal metadata format.

5.4 Retrieval of Rich Metadata

There are several protocols used within the digital library domain for retrieving details of electronic resources, which require, at a minimum, the return of a simple Dublin Core metadata description. These include the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) (Lagoze, et al, 2004) and Z39.50 when conformant to the Bath Profile (Lunau, 2003). For many resources much of the rich information in the metadata

describing the resource is lost in the process of ‘dumbing down’ to simple Dublin Core. One possible enhancement to these Dublin Core records could be to include a further ‘dc:relation’ property whose value is a by-reference pointer that will allow retrieval of the full metadata description. This by-reference pointer could be an OpenURL. In fact, implementing this option will effectively provide an OpenURL ‘Link-To’ Resolver service for the application.

Such a by-reference link will be provided within OAI-PMH simple Dublin Core records supplied by the JISC Information Environment Service Registry (IESR) (Apps, 2004b). IESR contains details of collections of resources, described using a collection description schema, along with descriptions of the services that provide access to the collections and relevant agents. This retrieval link as implemented by IESR, shown in Figure 4, is an example of using the OpenURL Framework’s experimental simple Dublin Core metadata format.

<code>http://iesr.ac.uk/service/ourlinkto?</code>	IESR OpenURL ‘Link-To’ resolver
<code>url_ver=Z39.88-2004</code>	
<code>&url_ctx_fmt=info:ofi/fmt:kev:mtx:ctx</code>	Key/Value ContextObject follows
<code>&rft_id=http://purl.org/doi/iesr.ac.uk/1084445595-14535</code>	Referent – identifier of required IESR entity
<code>&svc_val_fmt=info:ofi/fmt:kev:mtx:dc</code>	Type of service requested follows described using the Simple Dublin Core Profile
<code>&svc.format=text/xml&svc.type=Collection</code>	XML description of a collection requested.

Figure 4. An Example IESR By-Reference OpenURL Link

5.5 Further Uses

There are more novel uses of OpenURL appearing. Los Alamos National Laboratory Research Library has built an OpenURL Resolver interface to a repository of complex digital objects to service dissemination requests, including a MARC XML to MODS conversion service (Bekaert et al., 2004). This is an example of a resolver interworking with an OAI-PMH repository. RSS (RDF Site Summary) is increasingly used for news feeds and data syndication. A new RSS module allows the embedding of an OpenURL Framework ContextObject within an RSS feed (Hammond, Hannay & Lund, 2004). This would enable the passing of contextual information to a downstream application that could then provide appropriate services to a consumer of the feed. There are plans to include OpenURL links from the *Connotea* social bookmarking tool (Lund et al., 2005).

6 User Studies

OpenURL technology has very quickly become an established part of electronic publishing services to academic readers, whether researchers, learners or teachers, from both libraries and electronic resource publishers. OpenURL technology assists in the delivery of discovered articles directly to the reader. Thus it supports the provision by Zetoc of an integrated, ‘joined-up’ digital library service supporting the paradigm of ‘discover – locate – request – deliver’. Evaluation work undertaken on the use of Zetoc shows that OpenURL linking is well used and appreciated by readers in institutions that have a resolver.

Zetoc logs all accesses to the ‘More information’ link from a full record page, and these show a steady increase. During March 2005, there were 4625 accesses to an institution OpenURL resolver, Zetoc currently having 45 registered. There were 8681 accesses to the default page shown to users without an OpenURL resolver, and from that page 4926 accesses to LitLink. Zetoc receives no complaints to the helpline about OpenURL linking, implying user satisfaction with this part of the service.

An evaluation study (Eason et al., 2004) investigated users’ opinions of Zetoc OpenURL linking, based on two questionnaires, the second following the introduction of this document delivery method, and a few group interviews. There were very positive, even excited, responses from users who had explored the OpenURL linking options, the ‘active integrators’, and who were at institutions that provide an OpenURL resolver and many journal subscriptions. Users at other institutions where only the default resolver was available were sometimes confused when access to the full text of an article was denied to them, but they still made use of it.

Another study (Eason & Harker, 2003) looked at the views of the librarians who provide the OpenURL service to their institutions. Librarians are very enthusiastic about this technology despite the work involved in maintaining a resolver and its knowledge base.

7 Conclusion

Any standard is useful only if it is adopted and widely used within relevant communities. Z39.88-2004, the OpenURL Framework, has already proved itself by its enabling of appropriate copy reference linking within the

scholarly information community. OpenURL technology provides benefit to readers by enabling delivery of discovered articles electronically directly to their desktops. NISO's endorsement of the standard is opening the door to its wider deployment, to realise the vision of the OpenURL Framework facilitating, to quote Herbert Van de Sompel (Brunning, 2003), the originator of OpenURL: "a dynamic, personalised link structure on top of the existing static Web link structure".

Acknowledgements

The Zetoc service, including its development, is supported by the Joint Information Systems Committee (JISC) of the UK Higher and Further Education Funding Councils, who also funded the involvement of an author in the development of the OpenURL Framework standard. The Zetoc data is provided by the British Library.

References

- Apps, A. (2005). Guidelines for Encoding Bibliographic Citation Information in Dublin Core Metadata, from <http://www.dublincore.org/documents/dc-citation-guidelines/>, 2005-04-13.
- Apps, A. (2004a). zetoc SOAP: a Web Services Interface for a Digital Library Resource. *Lecture Notes in Computer Science*, 3232, 198-208.
- Apps, A. (2004b). A Registry of Collections and their Services: from Metadata to Implementation. In, *DC-2004: Proceedings of the International Conference on Dublin Core and Metadata Applications, October 11-14, 2004, Shanghai, China* (pp 67-73). Shanghai Scientific & Technical Literature Publishing House.
- Bekaert, J., Balakireva, L., Hochstenbach, P. and Van de Sompel, H. (2004). Using MPEG-21 DIP and NISO OpenURL for the Dynamic Dissemination of Complex Digital Objects in the Los Alamos National Laboratory Digital Library. *D-Lib Magazine*, 10(2), february2004-bekaert.
- Brunning, D. (2003). Interview with Herbert Van de Sompel, Creator of OpenURL/SFX. *The Charleston Advisor*, 4(4).
- CrossRef. (2003). OpenURL & CrossRef, from <http://www.crossref.org/02publishers/16openurl.html>, 2005-04-21.
- DCMI. (2005). Dublin Core Metadata Initiative, from <http://www.dublincore.org>, 2005-04-13.
- Eason, K., Harker, S., Apps, A. and MacIntyre, R. (2004). Towards an Integrated Digital Library: Exploration of User Responses to a 'Joined-Up' Service. *Lecture Notes in Computer Science*, 3232, 452-463.
- Eason, K. and Harker, S. (2003). The Impact of OpenURLs on End Users, from <http://metadata.mimas.ac.uk/ITAM/evaluation.html>, 2005-04-14.
- EDINA. (2005). The OpenURL Router, from <http://openurl.ac.uk/doc/>, 2005-04-13.
- Google. (2005). Google Scholar, from <http://scholar.google.com>, 2005-04-13.
- Hammond, T., Hannay, T. and Lund, B. (2004). The Role of RSS in Science Publishing. *D-Lib Magazine*, 10(12), december2004-hammond.
- Lagoze, C., Van de Sompel, H., Nelson, M. and Warner, S. (2004). The Open Archives Initiative Protocol for Metadata Harvesting, from <http://www.openarchives.org/OAI/openarchivesprotocol.html>, 2005-04-13.
- Lunau, C.D. (2003). The Bath Profile: what is it and why should I care?, from <http://collectionscanada.ca/bath/ap-bathnew-e.htm>, 2005-04-13.
- Lund, B., Hammond, T., Flack, M. and Hannay, T. (2005). Social Bookmarking Tools (II). *D-Lib Magazine*, 11(4), april2005-lund.
- MIMAS. (2003). MDL Litlink, from <http://litlink.mimas.ac.uk>, 2005-04-13.
- NISO. (2005). Z39.88-2004, The OpenURL Framework for Context-Sensitive Services, from http://www.niso.org/standards/standard_detail.cfm?std_id=783, 2005-04-13.
- NISO AX and Apps, A. (2004). Z39.88-2004: The Key/Encoded-Value (KEV) Format Implementation Guidelines, from http://www.openurl.info/registry/docs/implementation_guidelines/, 2005-04-13.
- Openly. (2005). OpenURL Referrer for Google Scholar, from <http://www.openly.com/openurlref/>, 2005-04-13.
- OpenURL. (2005). Registry for the OpenURL Framework, from <http://www.openurl.info/registry/>, 2005-04-13.
- Van de Sompel, H., Hochstenbach, P. and Beit-Arie, O. (2000). OpenURL Syntax Description, Draft Version 0.1, from <http://www.openurl.info/registry/docs/pdf/openurl-01.pdf>, 2005-04-13.
- Zetoc. (2005). Zetoc Electronic Table of Contents, from <http://zetoc.mimas.ac.uk>, 2005-04-13.