

A low-cost OpenURL resolver for UK HE/FE: a scoping study

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Executive Summary

This is the report from a scoping study funded by JISC to investigate whether comprehensive deployment of OpenURL resolvers within UK Higher Education and larger Further Education Institutions is feasible and desirable. The rationale for the study was to determine whether there is a role in UK HE/FE for a low-cost OpenURL resolver delivering the minimum essential functionality. The study was informed by desk-research, interviews and email correspondence with key stakeholders and by responses to a web-form questionnaire. The authors found that while there is widespread take-up of link resolvers in the larger Higher Education Institutions (HEIs) in the UK, there remains unmet demand among the medium and small sized institutions. Those HEIs without believe that they would benefit by implementing a resolver. There appeared to be very little demand in the Further Education Sector. Use of A&I databases is far less common in FE than in HE and students in FE often rely on services that are specifically targeted at their subject areas and provide full text; in FE some databases are effectively 'one-stop-shops' for students. Among those institutions that currently license link resolvers there is discontent about the extent to which they must configure the Knowledge Base (KB) for licensed content that is UK-specific. The report indicates the baseline features and functions that are required from a link resolver. It recommends that further work be done to explore the feasibility of centralised, collaborative UK-focussed link resolver based on a KB. The suitability of OpenSource and Collaborative Developments should be evaluated as the basis of such a solution. A key requirement for this work is that it should be developed by a team consisting not only of technical staff; serials librarians with experience of KB-configuration and understanding of the NESLi2 licence packages must also be involved in the specification and development of such a service.

1 Introduction

This is the report from a scoping study funded by JISC to investigate whether comprehensive deployment of OpenURL resolvers within UK Higher Education (and larger Further Education Institutions) is feasible and desirable and whether JISC should commission EDINA to explore and propose a suitable architecture for such a tool. The objectives of the scoping study are:

- to re-state and review the 'appropriate copy problem' in the light of developments in the past five years, both technical and business, as seen from the point of view of the stakeholders (see below) and the JISC Information Environment; to include OA repositories as well as commercial sources of supply of full text of articles.
- to ascertain the current extent of deployment of OpenURL resolvers, their financial cost, the issues faced by libraries in set-up and maintenance, and the technical issues involved in incorporating such resolvers into institutional systems.
- to compare and contrast the use of a 'knowledgebase' with the 'rights evaluation scheme' and with a 'licence registry'.
- to assess the 'gap' in take-up of such resolvers and the loss in productivity for staff, students and libraries, and the potential saving to institutions with the provision of a low-cost OpenURL resolver.

2 Background

The OpenURL framework for open reference linking in the networked information environment was developed by Herbert Van de Sompel at Ghent University in a project conducted between 1998 and 2000 (see Van de Sompel and Bein-Arie 2001). The OpenURL framework was designed to address the 'appropriate copy' problem. This is the fact that any single journal article (or other information object) for which descriptive metadata is available (typically, conventional citation details such as author, year, journal, volume, issue and page) may be available from many different service providers. In an electronic environment, the user desires a seamless link from a reference to the paper it describes. If the user is affiliated with a library, they may be authorized to access the paper from one or more services to which their institution subscribes. If a link directs them to a different service, access may be denied or payment may be requested.

The framework was declared a standard by the US National Standards Organisation NISO in 2004 (ANSI/NISO 2004). The NISO standard does not specify the function performed by an OpenURL Resolver, so the "appropriate copy" problem for which OpenURL was originally devised is in fact only one possible service; however at the current time the term "OpenURL Resolver" is commonly regarded as synonymous for a service that addresses the appropriate copy problem by attempting to locate articles that are freely accessible to the end user.

The OpenURL is generated by a referring service, which can be any source of a journal reference. The OpenURL must contain information about the article, and optionally may contain information about the referring service, the end user making the request, and the type of service being requested from the resolver. Of the optional elements, information regarding the referring service is the only one commonly included (though generally it is unlikely to be useful for anything other than logging). Information regarding the end user and service being requested is generally redundant, since for any institutional resolver that addresses the appropriate copy problem, the end user identity and desired function are implicit.

The OpenURL resolver parses the OpenURL to obtain information about the article, and consults a database (often called a "knowledgebase"; hereafter referred to as KB) of journal full text providers and subscriptions to determine the best available source for the end user. As well as onward links to full text services, local library holdings records and other services (inter library loan, google searches) may be offered. (See Powell 2001 for a good description of the conventional Open URL resolver designed to address the "appropriate copy problem").

This sequence assumes that the referring service knows which OpenURL resolver should be used as the "target" for each end user. This is a problem area. The technical issue has been addressed by the JISC funded OpenURL Router (<http://openurl.ac.uk/doc/>) and the OCLC OpenURL Resolver Registry (<http://www.oclc.org/productworks/urlresolver.htm>). These require institutions to register their link resolvers with the Router/Registry services and providers of online information services (such as e-journals publishers and aggregators) to retrieve that information from there. This works

well where the service provider is a JISC-funded initiative. Unfortunately, commercial service providers tend not to use the Router/Registry. Instead, they require their customers to configure the referring service with information about their link resolvers. .

3 Methods

We used desk research to scope the background and recent developments in the field of link resolution in UK Higher and Further Education. This gave us a formal account of the current environment. A preliminary interview with the e-resources librarian from a large research library (JISC Band A) helped us to fill out our preliminary picture with detail about the criteria for selection, the challenges associated with implementation and the role of a link resolver within a suite of library automation products used in a UK research library.

We then reviewed information published on the internet to determine to some degree the extent to which link resolvers have been adopted in UK HEIs. A webpage administered and published by Mimas indicates which, if any, resolver is used by each of the institutions subscribing to Web of Knowledge (http://wok.Mimas.ac.uk/full_subscribers.html). This is a good place to start because it is a publicly available source of information about how link resolvers are distributed across a large number of institutions, i.e. those institutions that are subscribed to Web of Knowledge (currently 133 UK HEIs). We augmented this with information published by institutions themselves and by vendors of link resolvers. This provided us with a draft list of institutions that ostensibly have link resolvers and those that do not. As part of an exercise to recruit interviewees (see below), we contacted staff at 50 institutions that we believed did not have resolvers and discovered that many of them do, now, have resolvers. It was beyond the scope of this exercise to conduct a fully comprehensive survey of link resolver adoption within the sector but we believe that this exercise has given us a sufficient overview to gauge take-up and spread across different products and institution size.

To gather information from HE librarians about their experiences regarding the ‘appropriate copy’ problem and link resolvers, we interviewed staff at seven institutions that are currently subscribed to link resolver products and three from institutions that are not. The staff interviewed were those who are or (in institutions that currently do not have resolvers) would be, involved in the selection and implementation of link resolvers. In this report, we use the JISC Bands as indication of institution size. We clustered bands into Large (JISC Band A—C), Medium (JISC Band D—F) and Small (JISC Band G—J). The interviewees are referred to throughout the report by a number which refer to the chronological order in which the interviewed (i.e. it does not contain information about the person interviewed). Information about the interviewees is outlined in Appendix 1.

Through desk research and our preliminary interview with the electronic resources librarian from a Large HEI, we developed a list of functions and features for a link resolver product. We asked our interviewees to categorise these into those that they consider to be essential, those that are only desirable and those that are not required. We used the interview data to revise the list of features and functions. We sent the revised list to two UK-based JISCmail discussion lists, *lis-jibs-users* (301 members; this is a user group for JISC-funded data services) and *lis-e-journals* (1919 members; this is an open list, set up by the UK Serials Group to discuss e-journals). We invited list members in UK HE to complete a web form indicating which features/functions are essential, which desirable and which are not required. We received 49 responses. The interviews and web-form responses reflected the frustration within UK HEI libraries that they are unable to obtain accurate and current information about the e-journals packages negotiated for UK HE as part of the NESLi2 initiative. We contacted Content Complete, the organization responsible for negotiating licences to those packages on behalf of the community to ask for their views. Adoption of the ONIX-SOH¹ standard by subscription agents also emerged as an important factor. We contacted

¹ ONIX for Serials is a family of XML formats for communicating information about serial products and subscription information. There are three formats available. They are: SPS (Serials Products and Subscriptions) used to communicate information about serial subscription products with or without pricing information; SOH (Serials Online Holdings) used to communicate electronic serials’ holdings details; SRN (Serials Release Notification) used to communicate information about the publication or electronic availability of one or more serial releases. ONIX for Licensing Terms addresses the issues surrounding licenses for electronic products. ONIX-PL (Publisher Licences) is the first manifestation of ONIX for Licensing Terms.

the Association of Subscription Agents and senior executives at three subscription agents to gauge progress with this.

As a first step in gauging demand for link resolvers in Further Education, we contacted librarians through the JISC Regional Support Centres. We corresponded with 11 by email and of those, we interviewed three. One of the interviewees considered there to be no requirement for a link resolver in FE; this interview was short. The remaining two had some interest in link resolvers. The eight email correspondents who were not interviewed considered that there would be little, if any interest in link resolvers within the sector. Interviewees from FE institutions are referred to using the same code as above for HE.

4 Recent developments in the Information Environment and their impact on the ‘appropriate copy problem’

Every library management system vendor offers a link resolver

Over the 8 years since the launch in the market of SFX, the first link resolver product, link resolution has become a standard feature among the suite of products offered by library automation system vendors. (On 26 March 2008, Wikipedia lists OCLC WorldCat Link Manager, Swets SwetsWise Linker, Serials Solutions 360 Link, Innovative Interfaces Inc. WebBridge, EBSCO LinkSource, Ovid LinkSolver, SirsiDynix Resolver, Fretwell-Downing OL2, TDNet TOUR, Bowker Ulrichs Resource Linker and Infor Vlink.).

As well as commercial vendor offerings, there are home-grown solutions such as GoldRush which was developed by the Colorado Alliance of Research Libraries in 2000 and reSearcher, a suite of Open Source library automation products developed by the Simon Fraser University Library (see <http://researcher.sfu.ca>). GoldRush is not open source but is available to libraries outside the Colorado Alliance at a lower price than comparator commercial offerings². In the UK, there is also EDINA’s GetCopy (developed as an output of the Zblsa project) which is freely available to UK HEIs and FEIs. Unlike the other link resolver products listed above, GetCopy does not rely on a KnowledgeBase; it is premised on the Rights Evaluation Scheme (described in Section 5 below).

HEIs generally want resolvers – but where resources are scarce it is not top priority

Not only do most vendors now offer link resolvers among their suite of products; in higher education, libraries tend to wish to provide seamless linking (through a resolver) to their users. Not all HE libraries can afford to do so but ubiquity is a pressure in itself; libraries do not wish to be left behind. Among interviewees, the relationship between the size of an institution (as indicated by JISC band) and likelihood that it has a resolver was consistent with our survey of coverage within the community. Most in Bands A—F either have one or are seeking one now; the exception is Interviewee 10 who considers the cost to be prohibitive. Resolvers in the smaller institutions are less common due to price (rather than the perception that they require a lot of work to implement). All of the HE-based librarians interviewed either have or want a link resolver but for some smaller institutions it competes for scarce funds with other more visible tools like a federated search module, an electronic resource management system and also content.

It’s difficult for us to justify because we’re a Band C institution and we don’t have a substantial research profile; it’s a lot of money to spend on something that doesn’t address our core users. If we had more money, we’d probably spend it on learning resources rather than something like this. (Interviewee 10, HE).

Many of the interviewees suggested that the widespread adoption of resolvers makes it important that the institution have one, as an indicator that it is keeping up with other Universities.

We need to get one to keep up with other institutions; it’s a bit like a bank without an ATM. (Interviewee 10, HE).

There’s been no pressure from the institution but there’s been pressure from me because I know that many, many other institutions are using link resolvers. (Interviewee 13, HE).

² The Colorado Alliance would be willing to investigate development of a mirror site in the UK if this appeared to be a fruitful avenue for UK users (George Machovec, Director, Colorado Alliance of Research Libraries, personal communication, 24 March 2008).

Interviewees' primary motive for getting a resolver was that they wanted to get best value from their subscribed resources by providing links to full text from wherever the user finds a reference or citation, be it an Abstract or Index database or Google. Users expect the discovery—delivery chain to be seamless and librarians want to meet that expectation.

When we looked at our ILL [inter-library loan] statistics, we discovered that 25% were for materials that we already have online so our users obviously, weren't finding them. (Interviewee 6, HE).

We try to go full text where possible but can't always...Users can't understand why they can get full text on some things and not on others. They assume that everything within a resource is full text and then get frustrated and annoyed when they find something and can't link to full text...(Interviewee 12, HE).

...we're paying a lot of money for these resources and we could get more value out of them. At present, students can search [a leading A&I database], find something really useful and we may have print and maybe even an e-copy but there's no way for them to know that we have the full text...I'm confident usage would increase if we had a link resolver. (Interviewee 13, HE).

Several interviewees referred to the fact that Google is one of the first places that students, and often staff, begin searching for resources.

If they're coming through Google, hopefully, they'll be resolved within our IP range. (Interviewee 6, HE).

Google Scholar does work with [a leading vendor] so that if it recognises us by our IP range, it provides links to things that we hold. (Interviewee 9, HE).

That would be our main interest in a resolver; that it takes our students from Google to our resources. (Interviewee 11, FE).

OA and link resolvers

One of the objectives of this study was to consider how changes in the information environment affect the issues being addressed here. Our interviews re-iterated what we found in the literature. The significant changes are: that link resolvers are now available from most library systems vendors; and that users are increasingly intolerant of services providing data without links to full text. We were interested also to discover whether librarians consider open-access repositories to be legitimate or important targets for their resolvers. Since JISC last explored the development and use of a link resolver within the JISC IE a network of open access (OA) repositories including institutional and subject-based repositories has emerged in UK HE. These repositories contain versions of research papers (including published and unpublished papers) that are available on the open web. Many papers published in subscription journals are available also in OA repositories. Thus, users are not necessarily reliant on library subscriptions to obtain the information they need; where no subscription is available, the user may still be able to obtain a copy of a research paper. The difficulty for users is that they will not necessarily find these papers when they need them. This is a problem for authors too; they put their papers in repositories because they want readers to find them. If it were possible to include the content in OA repositories among the targets of link resolvers, libraries could leverage advantage from the plethora of OA papers available in repositories throughout the world. The challenge to including OA repositories among a link resolver's targets is that the repository contains a collection of unrelated papers whereas most link resolvers rely on a KB consisting of information about subscriptions to journal titles. Successful linking to repositories requires a resolver that is not dependent on subscriptions information configured at the journal level. Such a dependency is unnecessary, and in fact is just an artefact of the assumptions underlying the KB structure: if a resolver is based on a KB designed exclusively for configuring journal level subscriptions, it is difficult to link to individual articles that are hosted in a service that does not have a journal-level structure. Linking to a specific article in a collection of unrelated items presents no difficulty in OpenURL, however, as the standard supports linking at the article level.

The information we gathered through interview suggests that although the link resolvers currently in use include Open-Access journals amongst their targets, few include Open Access Repositories. Sugita *et al.* (2007) report their efforts to configure a link resolver to search an institutional repository (IR). The solution was based on development of the repository rather than the resolver. It would not be efficient for a link resolver vendor/supplier to implement a solution that depended on customization of every repository of interest to UK researchers. Fortunately, Intute Repositories Search (IRS) will harvest repositories into a central database and provide a machine-to-machine

(m2m) interface onto that database; this may be searched by a central OpenURL resolver. (IRS is expected to be available from the end of July 2008).

The success of such development would depend on a number of factors. First, the OpenURL to be resolved must have sufficient information to properly identify an article in the repository. Second, the metadata captured by the repository must be of sufficient extent and quality that the OpenURL may be resolved (i.e. both parts must have sufficient information to allow matching). Third, Intute's configuration of the database of harvested records must effectively balance the number of 'false positive' results with the number of 'false negative' results in any results set. (The appropriate balance will differ for a national solution compared to a local solution as the total size of a local database and probability that false positives will be onerous on the user is significantly smaller than for a database containing records for hundreds of repositories). Fourthly, the database will have to allow searching only for those records that provide full text (an OpenURL resolver will not wish to provide links to metadata-only records).

It is perhaps not surprising that our interviewees tend not to be targeting OA repositories with their link resolvers. Three of them either do or intend to target their own institutional repository (IR). Interviewee 8 also told us that arXiv and other large, international subject-based repositories are available as targets in the SFX KB but her/his institution has not switched them on. Interviewee 9 pointed out that as repositories hold individual articles and link resolvers are based on journal-level information, there is no natural fit between content in repositories and link resolvers.

During our preliminary interviewing, another possible relationship emerged between link resolvers and repositories. Our interviewee suggested that as well as linking into OA repositories, in future, libraries may also wish to use their link resolvers to link out of their local IR to full text published elsewhere. This may be important because some OA repositories include records that consist only of metadata describing research papers. The volume of metadata-only records in institutional repositories in the UK may rise over the next four years as institutions use the IR as the focus for the Research Excellence Framework (the replacement for the Research Assessment Exercise). A systems librarian at the library of a Band A institution told us that the University will mandate deposit by staff of research output. S/he anticipates that many academics will comply with the mandate by depositing metadata-only records. Thus, a large proportion of new deposits will lack full-text. The librarian interviewed suggested that links from those records to full-text (in published journals) would be useful to repository users (and thus to authors whose papers are more likely to be read if the discovery to access chain is seamless). When we asked interviewees about linking out of IRs, they did not understand the question so this would appear to be an innovative idea by a librarian at one large institution.

5 What is the basic functionality of a link resolver product?

The key criterion for a link resolver is that it takes an OpenURL and directs the user as seamlessly as possible to the most appropriate copy of the item sought. In other words, the user finds details of an article (or other piece of information) in a discovery service (e.g. a search engine or bibliographic database) and is directed either to an electronic copy that they are authorized to use or to a print copy. Cost aside, this most basic criterion is difficult to achieve accurately and reliably because the environment is complex and fluid and because data are often inaccurate, incomplete or outdated (Cullen 2007³). A library may have access to different parts of a journal through different service providers, e.g. current content from a journal aggregator and past issues from JSTOR. Clearly, there is fluidity as 'current' content becomes legacy content. Other changes occurring in the serials world include, e.g. that: a journal title changes; a journal ceases publication; ownership is transferred from one publisher to another; or the content of an aggregation changes. In an initial discussion, the electronic resources librarian at a large UK HEI told us that the library maintains 30k active links to 24k journal titles using its KB-based resolver.

At its most basic, Goliath considers the functionality of a link resolver to be that 'they locate articles from A&I databases, strengthen the role of interlibrary loan, and enable metasearch' (Goliath 2007). This implies that a link resolver not only resolves OpenURL queries; it also populates an ILL/DD request form, directs the user to the OPAC when full-text electronic copy is

³ This study was commissioned by the UK serials group which has now established a working group, co-chaired by NISO, to progress the recommendations from the report (see <http://www.uksg.org/kbart/>)

not found, and searches the resources available to a library user. Accurate and reliable link resolution depends on a variety of features and functions. As the market develops and increasing numbers of librarians license resolvers, librarians are more familiar with the criteria that contribute to effective link resolution; they use these to select from the range of products available.

Through interview, we asked librarians how they choose a link resolver and what features and functions take priority. The priority of a focused list of features and functions was also the subject of the online web form that we posted to the JISCmail email discussion lists lis-e-journals and lis-jibs-users (see www.jiscmail.ac.uk).

We discovered that although librarians often conduct a thorough comparative evaluation, others simply choose the link resolver offered by the supplier of their library management system (LMS). There are a number of reasons for doing so: the price may be lower as the vendor offers a discount for more than one product; it can also save a lot of time spent evaluating and procuring a link resolver if the library can simply take what is available with the LMS.

We looked around at different products in the first instance but, in the end, it got tied up with the purchase of our integrated library system; we went with [the product offered by the same vendor as the ILS] ... we accepted that this was the product we were going to get and we were going to have to work with it. (Interviewee 1, HE).

It's with the same supplier as our LMS. We started with LinkFinderPlus. ... When ExLibris bought Endeavour they offered us SFX as a replacement so we simply moved from one to the next. We're very satisfied with what we have now. (Interviewee 4, HE).

We use [name of a link resolver] which is the link resolver from the vendor of our LMS; we bought the [link resolver] module when we went live in 2005. I had no choice! (Interviewee 5, HE).

Even those who do evaluate a range of products would like to minimise the number of vendors that they work with and are aware that the price from a vendor with whom they currently have no relationship is likely to be higher. Interviewee 6 is currently comparing three link resolvers. Interviewee 7 conducted a thorough comparative evaluation and considered, among her/his criteria, the ease of implementing a link resolver and federated search tool from the same vendor.

I would be happier using just one or two vendors at most. ... We don't yet have any products from ExLibris so that would be an unusual thing for us to choose; we have relationships with the other two but SFX, is the brand leader so we'd like to take a look at it and see how it goes. Pricewise, we probably won't be able to negotiate a very good deal with ExLibris unless they really want to sell it to us and get us buying other things. (Interviewee 6, HE).

We assumed, at the outset, that it would be a lot easier to implement if we took the federated search and link resolver from the same vendor so this was a criterion. We had very little time to implement (just the summer before launch) and we thought it would be more efficient to take the products from the same vendor. (Interviewee 7, HE).

Selection criteria for link resolvers

Because library automation products are expensive, both to license and to implement, libraries selecting products from the range available usually draw up a list of criteria as a basis for comparison. This study is considering the feasibility and viability of a low-cost resolver. This would probably offer less functionality than the market leaders – at a lower price. Clearly, in order to be useful (or even considered by libraries to be worth implementing) a low-cost solution must fulfil the baseline requirements. Requirements that are desirable rather than essential may not be included. A task for this study was to differentiate these basic essentials from the non-essential add-ons.

We gathered from the literature a list of criteria used by research libraries when selecting a link resolver product. Information in the literature refers almost exclusively to KB-based solutions so lists of criteria are premised on the assumption that the solution will be based on a KB. The results should give some indication of what is required from any link resolver product whether or not it is based on a KB. After all, any solution to the problem must be based on accurate and current information about the content licensed by the libraries using that solution.

We asked the librarians we interviewed to indicate which of these criteria they consider to be essential, which are desirable and which are not required. Their responses helped us to distill our list of criteria which was posted as a questionnaire to two UK library lists (lis-e-journals and lis-jibs-users). The list of features and functions is attached as Appendix 2.

This information gathered from the community of users and potential users was sufficient to indicate that most librarians selecting a link resolver require a relatively high degree of functionality. All but one item on the list that was circulated to mailing lists were considered to be either essential or desirable by most respondents. The exception was that the tool should be available for local installation. However, while many of the features/functions were considered essential by many and desirable by many others, there were a few features/functions that stand out because all or the vast majority of respondents consider them essential.

The list below indicates the features and functions that were considered essential by at least 39 of 49 web-form respondents.

- It should interoperate with other products that you use e.g. LMS, e-journal management
- It is easy to activate titles, i.e. easy to discover titles in the Knowledgebase and activate them. [This refers to the ease with which a librarian can take the standard KB, discover the titles to which their library is subscribed and activate them so that the resolver directs users to them]
- It is easy to record and report problems [to the vendor].
- It is easy to prevent local holdings information from being overwritten when the KnowledgeBase is updated.
- The Knowledgebase is sufficiently comprehensive and aligned with your holdings and is continuously updated.
- It resolves to titles in aggregator services as well as e-journals services [i.e. to journal titles held in collections that may include journals from different publishers, other formats such as book chapters and possibly also other types of media such as images].
- The interface is intuitive
- The vendor should have a good track record of responding to problems/issues.
- The vendor demonstrates a commitment to ongoing development.

Interview data provided more information about these requirements. When we began this work, we considered the possibility that a tool resolving queries to journal-title level may be less expensive to develop and deliver than one that resolves to article level whilst still providing a useful service. We asked interviewees whether article level resolution, as opposed to journal-title level resolution, is a requirement and to what degree of accuracy. The interviews suggested that journal-title-level resolution would not fulfill baseline requirements. With one exception, our interviewees want resolution to article level with a high degree of accuracy. Interviewee 7 is the exception. S/he chooses to present users with journal title level information so that where content is available from more than one provider, the user can choose her/his preferred provider, i.e. preferred interface. Interviewees' requirements vary regarding the percentage that resolve successfully to article level: one interviewee considered it important that more than 90% successfully resolve to article level; most others would like a success rate higher than 95%. Interviewee 9 told us that resolution to journal title level is available free of charge from the vendor providing her/him with journal-title data. S/he used this free service with some satisfaction for one university term before licensing the article-level resolver. As a free service, s/he considered it to be very good value; users would find the articles that needed with a little extra effort and at no cost to the library. Clearly, Interviewee 9 considers article-level linking to be an important function, however as s/he now pays for this level of service.

Although we asked only about e-journals and other scholarly materials (e.g theses and conference proceedings), several interviewees and respondents to the questionnaire indicated that e-books are becoming important. Librarians want their link resolvers to surface all content as required by the user regardless of the format of the content and regardless of where it is held (i.e. in an e-journals collection, an aggregation or a subject-based database consisting of various formats and media types).

Most respondents to the questionnaire (35) consider it desirable that the resolver they select already has a well-established user base within the UK. All interviewees who have a resolver also indicated that it is important to select one that already has an established user base within UK HE. A number of reasons emerged in the interviews. First, it means that there are experienced users within the UK HE community who may be consulted during set-up. Several interviewees found the help of colleagues at other institutions to be invaluable. It also suggests that the resolver has been tried

and tested at other institutions. Second, a high number of users in the UK increases the incentive for the vendor to develop and maintain the service with reference to UK needs (e.g. by including NESLi packages); the librarians interviewed also like the fact that when they report a bug, all the other institutions benefit too – it's a collaborative enterprise. Third, a well-established user base suggests a high degree of acceptance, i.e. it's a good tool. It seems likely also that a product with a well-established user base is a viable product with a future; librarians do not wish to invest time implementing a service that may subsequently be withdrawn. Nevertheless, two interviewees that do not currently have resolvers said that they would support a JISC-funded initiative. Interviewee 13 because it would have high take up within the community and Interviewee 10 because they trust that a centralized solution funded by JISC would represent good value for the community; collaboration would maximize the value of each party's work.

It needs to be something that's going to be around for a long time as far as we know – so we're not going out in on a limb - it shouldn't be there for 1,2 or 3 years and then disappear and no longer be around on the market. We'd want to know that other HEIs were using it because I'd contact other librarians and ask their opinions. For that reason, an initiative from JISC/EDINA would be useful - other institutions would take it up. (Interviewee 13, HE).

One reason I'd like to see this done centrally – through JISC – is the economy of scale which involves being hosted. Economies of scale: when URLs change, they only have to change once for everybody and when new editions come, they only need to be changed centrally. (Interviewee 10, HE).

The requirement that a resolver be available well into the future is indicated also by the wish, expressed by two interviewees from Large institutions that their selection be reviewed no more frequently than every 3 or 5 years respectively. The process is costly in time during both selection and implementation.

Several interviewees who have resolvers mentioned the issue of NESLi packages and how accurately they are reflected in the KB. Interviewee 8 described the problem as did Interviewee 5. *The US universities are subscribed to different permutations of the same thing. If you go into SFX and want to activate Sage Complete that we take through NESLi, it'll give you all the content that's in Sage Complete but the dates are all wrong because NESLi only covers a restricted range of dates so we have to customise it and in doing that, we have to be careful with updates. Anything that you customise, when you run an update, you have to treat as an exception. You have to be really careful that what's in the KB is what you've got. You really need to understand your licence in great detail in order to know whether it's safe to just switch it on or whether you need to make changes before it's safe to do that. When I've uploaded things from the catalogue we normally have an error rate of around 15%. Probably around the region of 20% I have to work on myself. I have a comprehensive list of exceptions because dates are different or we can't have the whole package because their package doesn't match our package. (Interviewee 8, HE).*

I spent 7 months chasing Blackwell for this and eventually they gave me a list which was completely inaccurate and there were no close dates. If I can't get that information from Blackwells, SWETS isn't going to have it and NESLi obviously doesn't have it. I don't care where it comes from; if I could get correct NESLi files, that would make my job so much easier. ...Quite often it'll give you the names of the journals that are included and the list prices but I need the direct URL, the ISSN and the years. We're getting that from 2 of the 9 NESLis but not the others... For me as an administrator, the most frustrating thing is not being able to get genuine NESLi lists. (Interviewee 5, HE).

Clearly, accurate and current data about the content of packages negotiated as part of the NESLi2 initiative would be welcomed by UKHE librarians. Content Complete, the organization responsible for negotiating the NESLi licences are well aware of this issue. They consider it to be the joint responsibility of publishers and link-resolver vendors to ensure that NESLi packages are reflected accurately in KBs. Albert Prior, one of the Content Complete Directors said 'It has not been our intention to act as a receiver or distributor of this information but rather to get publishers and suppliers to recognize the benefits for both sides and to set up systems between themselves.' To this end, Content Complete has organized a workshop on 17th June 2008 to progress the issue. It will be attended by publishers, vendors and librarians. Until some arrangement is made between publishers and link-resolver vendors, librarians must continue to configure the KB to reflect accurately the content of the UK-specific packages to which they are subscribed. This is duplication of effort.

Another issue considered important by interviewees and web-form respondents was the fact that discovery tools frequently present users with a link button whether or not the library has a subscription to the full text. Thus, for content to which the library is not subscribed, the button does not fulfil the function that the user expects. There was a strong feeling from all interviewees who discussed the issue that where a link button is presented to a user, it should always resolve to full text; a link button that may or may not resolve to full text is worse than no button at all because users do not understand the inconsistency. Users also tend to think that if a button does not work, it is the fault of the library. Interviewee 5 explained that there is no option to exclude these 'non functioning link buttons'. 'It's how link resolvers work' s/he said. It made her question whether the link resolver provides a better service than the 'current journals' list that she provided before implementing the resolver.

While these link buttons that do not resolve to full text are frustrating for librarians and potentially misleading for users, their exclusion is not provided for in the OpenURL standard. OpenURL provides a mechanism for linking from a referring service to a resolver, i.e. a 'one-way' request. To make the appearance of OpenURL links context sensitive (i.e. so that they appear only when the resolver can offer access to the article), a machine-to-machine exchange of information between the two services would be required. This is technically possible but is not currently covered by the OpenURL standard. Just as the commercial vendors seek to be standards compliant, so too do JISC-funded initiatives.

6 Extent and cost of deploying link resolvers in UK HE

Part of the remit of this study was to assess take-up of link resolvers in UK HE/FE and the unmet demand within the sector. Published data helped us to identify which HEIs currently have resolvers and which do not. The interviews gave us some indication of whether those without resolvers represent unmet demand. Information about resolvers in FE was gleaned directly from staff at JISC Regional Support Centres and from FE librarians. We interviewed three librarians.

Link resolvers in UK HEIs in 2008

Figures available on the website of the JISC-funded national Data Centre Mimas lists 75 UK universities with proprietary resolver services. Our additional investigations suggest that another 15, i.e. a total of around 90 institutions have link resolvers. We believe this to be an underestimate and would guess that around 95 have resolvers.

Of the 90 that we counted, 56 are SFX and of the SFX users, 42 use either MetaLib or Verde (other library automation products offered by ExLibris). None of the universities using the Metalib federated search interfaces uses a resolver other than SFX. Looking at adoption of 10 other products, we discovered that most have only 1 or 2 subscriber institutions. Three have take-up levels of between 5 and 10; these are, in order of popularity, Serials Solutions 360 Link, EBSCO's LinkSource, and Innovative's WebBridge.

JISC lists 167 UK HEIs in its list of banded institutions (http://www.jisc-collections.ac.uk/jisc_banding/collections_banding_he.aspx). Thus, the number with proprietary resolvers account for around 57% of the total and of those, 60% use SFX. While a majority of Band A and Band B institutions (10/11 of each) have proprietary link resolvers, the proportion falls sharply in Band C downward. (approximately 75% in Band C, and 66% in Bands D and E have link resolvers). Half of Band F institutions have a link resolver and very few in Bands G to J (we found only 1 Band G and 2 Band I institutions with link resolvers).

Link resolvers in FEIs in 2008

We found no evidence of adoption of link resolvers in Further Education. Most respondents to our query indicated clearly that they could see no role for link resolvers in Further Education. They said that students in FE require a higher level of support than those in HE and rely on a small number of online information resources that are tailored to their needs. In common with students in HE, those in FE are frequent users of Google. From library-provided resources, they tend to rely on a small number of online full-text databases for their information needs; they do not need to link from one resource to another. The largest FEIs do have HE-level students and staff who use discovery resources that do not include full text.

We tend to provide full-text databases. Students use the relevant database to find everything they need. We don't need a link resolver. (Interviewee 14, FE).

Before speaking with us, our FE-based interviewees (those at larger FEIs) knew little if anything about link resolvers. Two of them considered resolvers to be potentially valuable for linking the small number of discovery databases (abstracts and indexes) to potential sources of full text. Interviewee 2 found it difficult to estimate how much the institution would pay for a resolver. It may be difficult to fund because it would be 'nice to have' rather than essential and, at present, there are other priorities such as the transition to a new authentication scheme (Shibboleth). However, s/he suggested that, in future, a link resolver would become a priority..
I'm not talking about many things but if the students need things, I don't know when they need them and they just don't know that they exist... Funding is changing and, for instance, we've gone over to Shibboleth recently but the main impetus is that we'd have to pay for ATHENS in the summer but eventually Shibboleth will have to be paid for and we'll have to find money for that so it's simply a change in the way you spend the money. So it would become a priority. (Interviewee 2).

Unmet need and available funds within UK HE/FE?

Section 6 indicates the level of take-up of proprietary link resolvers within UK HE. Approximately 70 institutions in UK HE have yet to implement a link resolver. More than half of these fall within the Band G—J bracket where funds are scarce and a resolver is generally a lower priority than other resources. Based on interview data, we might reasonably expect those in the C—E bracket to pay £1--2k for a functional resolver. A tool fulfilling only the basic essentials should be considerably less expensive. A range of £500--1k may be appropriate for institutions falling within the C—J Bands. Thus, we might expect there to be a maximum total of around £50k p.a. to fund a low-cost (i.e. low-functionality) link resolver. As 100% take-up among the institutions that currently have no resolver is unlikely, a projected income of around £25k may be more realistic.

The challenge is that the success of any solution would be based on accurate and current data about subscriptions.

Costs to libraries of link resolvers

It seems that the total price of a link resolver includes three components: the licence, set-up, and implementation; the training; and a recurrent fee to maintain the licence. It is difficult to determine any element of the price of link resolver products let alone compare them. There are a number of reasons. First, pricing models vary across vendors. Second, prices are related to factors such as the number of links maintained or titles held and, in at least one instance, the number of institutions in the UK that subscribe to the product. Third, link resolvers are often not priced as discrete products – many libraries take a resolver as one part of a suite of products and receive a discount on that basis. Few interviewees were able or willing to provide details of prices paid for link resolvers. From the information that we did gather from interviewees, it seems that the recurrent price varies from £1—2k (+ VAT) per annum for a smaller institution using a product with less functionality than it would like to £6k (+VAT) per annum for a large institution seeking full functionality. This initial fee for implementation is difficult to determine because; price varies as above and some institutions have migrated from another product (when the vendor was taken over by another company). None of our interviewees was able to quote a price for a link resolver (rather than a suite of products) as a newly adopted product. Based on the information that we did glean, we would guess that implementation and training would be priced at approximately £4—5k (+ VAT).

We also tried to establish, through interview, the cost, in staff time, of configuring, implementing, launching, troubleshooting and maintaining a link resolver. The degree of variation was enormous. Interviewees did not consider the cost, in staff time, of configuration to be as important when selecting a resolver as the requirement for ongoing maintenance because the pre-launch stage may be funded as a project with dedicated staff. After launch it must be maintained by e-resources or serials staff and they want to be sure that this workload will be manageable. The resource committed to configure, launch and maintain link resolvers varied widely between institutions. Interviewee 6 expects one FTE to spend 4—6 weeks to set up the resolver and then 1—2 weeks troubleshooting after launch. Interviewee 5 spent 5 days configuring the resolver; the ongoing workload is half a day per week. Interviewee 7 spent 24.5 days configuring it and there are currently around four FTEs per week working to maintain 'an accurate KB', monitor functionality, install updates and troubleshoot, staff a helpdesk, activate titles, and contribute to maintaining the system. Interviewee 8 reported that configuring and maintaining the resolver took much longer than anticipated. It took a full 4—6 weeks to configure content in the system before launch and the ongoing commitment is around 5—6 days of an FTE per month. Clearly, some of this variation is explained by the size of the institution – but not all of it; Interviewee 8's collection is nearly twice

as large as Interviewee 7's collection yet the ongoing workload at Interviewee 8's institution is around 6—7% of that committed by Interviewee 7.

Livingston *et al.* (2006) provide good comparative information about the in-house technical resource required to configure, update and troubleshoot different link resolver products although prices are not available. An average of around 30—40 hours is required to configure before launch and another 30—40 hours after the launch. Resource devoted to ongoing operation varies from 0.16FTE to 0.34FTE depending on the product. At a rough estimate (taking into account salary plus a conservative estimate of on-costs at around 50%), this amounts to approximately £1500 to configure (pre- and post-launch) and an ongoing cost of around £10,000 per annum. The resource required to configure and maintain the link resolver in-house may be part of any evaluation of a proprietary or non-commercial offering.

Cost of not deploying a link resolver

One can imagine that when an effective link resolver is lacking, users will either undergo the manual process that pre-dated the (partially) joined up, networked environment, i.e. they will find a reference in an A&I database, note this, consult their library catalogue and then, perhaps, try to obtain a copy either electronically (if available) or in print. Alternatively, the user may give up at the first hurdle and seek sources that are delivered immediately at the desktop (see Conway 2007, and Conway *et al.* 2007 for evidence that researchers and students are now frequently unwilling to pursue an article that is not available immediately at the desktop). In the first of these scenarios, the cost may be as high as 30 minutes or more (depending on distance from the library) of a researcher's time (see Shaw-Kokot and de la Varre 2001). In this latter scenario, subscribed journals are underused and libraries fail to fully meet the needs of their users. The monetary value of this is very difficult to gauge. Volume of use is not always a good indication of monetary value. The important point is that when a library has a subscription to content that library users wish to read, both parties would like that the user finds that content.

Recent research indicates that while researchers are satisfied with online information discovery services, they are often frustrated that the content they discover is not actually available to them, e.g. because their library is not subscribed (RIN 2006). At the institution of one interviewee (Interviewee 9), use of Abstracts and Indexes was going down before the link resolver was implemented. The interviewee assumed that implementation of a resolver had reversed that pattern but was unable to confirm this as s/he had not gathered and analysed these usage statistics. Findings from a recent JISC-funded study on the Information Behaviour of the Researcher of the Future included that:

- *The introduction of electronic journal services impacts very negatively on print-only titles, such as the convenience and consumer acceptance of the new medium, raising big issues for the continuing value of the print legacy; and*
- *Convenience and digital visibility are crucial in the new information landscape.*

(Rowlands and Fieldhouse 2007).

The value derived from a resolver can be difficult for institutions to gauge. Some interviewees simply do not have accurate statistics showing how use of their full-text databases have changed since they implemented the link resolver. Others explained that there have been so many changes over the period since they implemented the link resolver that they are loathe to attribute the increase in usage to the link resolver alone; federated search, for example, may contribute to increased usage of subscribed resources. Interviewee 3 reported a doubling in use of some electronic resources but cautioned

...there are too many other variables. We have more e-journal collections than we had, we promote them more, and we have increased our information skills training over the same period so students should be more aware of what is available.

Interviewee 7 reported a 50% increase in usage and Interviewee 5 noticed no increase at all since the resolver was implemented.

These sorts of changes, coinciding with adoption of a link resolver make it very difficult to gauge the degree to which any institution lacking a link resolver might suffer from loss of productivity. Clearly, any library investing in a substantial volume of full-text resources wishes to maximize their usage and value. Purchasing a link resolver is one of many strategies for doing so.

7 Three solutions to the ‘appropriate copy problem’

The proposal for this project indicates our intention to compare and contrast use of three different models for resolution of OpenURL queries: the licence registry, the rights evaluation scheme and the Knowledge-Base. To date, as far as we know, only two of these models has been tested: the rights evaluation scheme (by the ZBLSA project; see below) and the KnowledgeBase. The Licence Registry was proposed by EDINA to members of the Association of Subscription Agents in 2000 and was one element of a proposal made by EDINA to JISC in 2000 but was not developed or tested.

The vast majority of link resolver products available in the market today are based on a KB. EDINA’s GetCopy solution is described by Goliath as being ‘by far, outside the norm’ in that it does not depend on a KB (Goliath 2007).

Licence registry

The licence registry solution is premised on the assumption that details about the vast majority of institutional subscriptions are stored in electronic form in the management systems of subscription agents. If information about the subscriptions of UK Higher Education Institutions were gathered in a registry, this could be used to resolve OpenURL queries. This would require the co-operation of subscription agents and it would require them to provide the information in a standard format. This would facilitate creation of a registry containing information about many but not all of the serials held in UK Universities; libraries sometimes negotiate contracts directly with content providers thus excluding subscription agents, e.g. for static backfiles purchased for a one-off payment (Cullen 2007).

The licence registry solution was explored in 2000 when EDINA submitted a proposal to the membership of the Association of Subscription Agents (ASA). A majority of ASA member organizations indicated that they would be willing to participate in such a scheme. Unfortunately, not enough of the larger subscription agents wished to participate. As these agents have a substantial share of the market, this was sufficient to make the proposed solution not viable at that time.

Five years ago, there was no standard format for electronic communication of information about serials. In 2008 the situation has changed. ONIX for Serials (<http://www.editeur.org/onixserials.html>) is now a NISO standard format for machine-to-machine communication of subscriptions details and thus provides the foundation for an efficient licence-registry solution. The success of a licence registry model would depend on the co-operation of subscription agents, on their widespread adoption of the ONIX for Serials standard to communicate the licence information and on their possession of accurate and current data about holdings.

Cullen (2007) reports that progress with ONIX-SOH (Serials Online Holdings) has been slow; only a few content providers currently provide data about serials in this format to vendors of link resolvers. Vendors interviewed by Cullen report the main obstacle to widespread take up as lack of will; as the current system functions, content-providers lack a strong incentive to change it. Furthermore, he reported that the size and complexity of ONIX-SOH messages introduce the possibility of misunderstanding. Some of his interviewees considered ONIX to be insufficient: it provides a means to list web links for serial items but lacks the capacity to describe how to link to individual journal volumes, issues or articles within packages. That said, Cullen reported that in June 2006 EBSCO and OCLC reported successful deployment of a web service to facilitate automated delivery of electronic holdings data in ONIX-SOH format to OCLC’s WorldCat. The JISC-funded AIMSS project (http://www.jisc.ac.uk/whatwedo/programmes/programme_pals2/project_aimss.aspx) has also demonstrated use of ONIX-SOH to transfer data about the holdings of libraries subscribed to Serials Solutions from the Serials Solutions database to SUNCAT. We consulted the Association of Subscription Agents and contacted executives at four subscription agents directly. ONIX-SOH is currently in use by the largest subscription agents. Its use is not yet widespread but some smaller agents are considering its implementation. The speed of uptake among agents may be related to speed of uptake by publishers. The currency and accuracy of information about ‘holdings’ as listed in a subscription agent’s database also depends on publishers.

Rights Evaluation Scheme

The Rights Evaluation Scheme (REM) was a solution to the 'appropriate copy problem' proposed and tested by EDINA as part of the ZBLSA project. ZBLSA II (the second funded phase) ran for two years to December 2003, aiming to build the "broker" for locating serial articles, as a shared services in the JISC Information Environment.

The project concluded that there was a requirement in the JISC IE for a general purpose locate broker, particularly to support institutions who do not own an institutional OpenURL resolver. A functioning broker was implemented, capable of executing multiple simultaneous queries to potential providers of serial articles (serials publishers and aggregators, tables of contents services, union catalogues and institutional OPACs). The REM was devised to differentiate between multiple possible providers, and locate the appropriate copy.

The REM involves a simple query being submitted by ZBLSA to a provider, and a simple response indicating if access to the specified article would be provided to a specified end user. REM would not deliver the article to the user; a positive response would indicate only that the end user would be given access, if she/he visited that provider's web site directly. This would allow ZBLSA to present the end users with only those links which would provide her/him with free access to the article.

The REM query mechanism could be tailored to the providers' requirements, in terms of the format and information passed. Most providers already published "link to" formats (possibly using the OpenURL standard) which constitute an HTTP request for a journal article; these mechanisms could be leveraged by simply adding one or two extra parameters that identify the user, such as IP address or an Athens institution identifier. Since providers were already evaluating users access rights, no extra capability for checking IP addresses or Athens identifiers would be needed; it would be necessary only to communicate the outcome of this evaluation to ZBLSA.

The REM response (from a provider back to ZBLSA) would need to be only positive or negative. This could be done with a plain text HTTP response, simple XML, or (simplest of all) just using HTTP response codes.

The important characteristics of the REM are:

- it would be a general solution available to all institutions;
- it would be 'lightweight', in that it would require no complex configuration of institutional licence data;
- it leverages the mechanisms already implemented by providers;
- it would be revenue neutral, and would not charge any fee to the user, the institution, or the publisher, and
- it would not itself access licensed resources, and need not therefore be treated as a trusted agent

The ZBLSA project was entirely dependent on the cooperation of publishers to implement the REM. The proposal was welcomed by the Institute of Physics and Ingenta, and successful implementations were quickly and easily implemented with these two providers. The response from other providers were either non-committal or dismissive, and ZBLSA could not gain the critical mass required for a functioning service. There appeared to be several reasons for this:

- REM is seen as a technology only relevant within the UK market;
- the UK market is regarded as too small, in comparison with the global market, to justify custom implementation (some publishers we spoke to were only just in the process of implementing Athens access management having resisted that for several years);
- ZBLSA was regarded as a competing technology by some publishers, for whom the priority was to build their own one-stop portal attractive to customers, and
- the development schedule of publishers is overstretched, and some publishers who agreed to consider REM indicated this would take over a year to complete.

The project concluded that where publisher cooperation is sought, this will only succeed if a very strong case, based on purely commercial arguments, can be made.

Since the project reported in 2004 there has been little change in the situation. There has been an increase in the use of OpenURL as a "link to" format by full text providers; this is welcome, and would reduce the development required by any successor to ZBLSA, but since most providers did already have (non standard) published "link to" formats it does not represent any real increase in capability. More positively, there has been some decline in the "one-stop portal" and an increase in support for interoperability and standard compliance, probably driven by the popularity of products providing federated searching and full text linking. This may be part of a general trend (see <http://www.programmableweb.com/> for details of "mashups, APIs and the web as a platform"), and in this context initiatives such as REM may become more welcome.

A study published by the University of Connecticut Libraries which compared different link resolver products, suggests that market share remains a factor that publishers consider when deciding whether or not to work with vendors of link resolver solutions (Livingston *et al.*, 2006). Publishers prioritise vendors with a large market share because doing so maximises the number of their subscribers that benefit from this work.

Knowledge-Base

As far as we know, the Knowledge Base is at the heart of all link resolvers currently available other than EDINA's GetCopy. A recent report for the UK Serials Group described the KB as *a directory of where all scholarly content is stored, embracing all of the incarnations of a given title, and how to link to them.* Cullen 2007, p. 9.

Goliath describes the KB as the 'the brain of the operation ... what you are paying for when you buy a link resolver'.

The KB addresses the complexity and fluidity of the market for e-journals by providing current and detailed information about each incarnation of a journal article. Of itself, this does not address the problem facing libraries. A library must customize the KB with its local holdings information so that it contains current and detailed information about the specific incarnations to which the library is subscribed. (Open Access journals may also be included). This includes not only articles in e-journal packages; more difficult to surface is the content in aggregated databases like WestLaw, LexisNexis or Literature Online, a database containing e.g. poetry and drama as well as journal articles. There may also be more than one 'appropriate copy' for a single article as the content in different aggregations and services often overlap. A function added recently to commercial link resolver products is 'overlap analysis'. This helps the library, on considering a new aggregation, to gauge the proportion of its content that is already available to the library in its subscribed services.

The environment is fast changing and the task of maintaining an accurate KB is substantial. Vendors are not 100% successful. KBs are often inaccurate, out of date or incomplete. The accuracy, comprehensiveness and currency of the KB is currently the focus for competition between different vendors (Cullen 2007, p.9). Vendors depend largely on content providers (publishers and aggregators) to provide accurate and timely information. Local customization and configuration of the KB are also expensive; the library pays not only the price of the service but resources its implementation and maintenance. Creation and maintenance of a good KB is a costly business which seems to be at odds with the term 'low-cost' which is at the heart of this project.

Comparing three solutions

The licence registry model would depend on a registry of licensed e-journals in UK HE that is both accurate and current. At present no such registry exists. In 2000, EDINA found that the largest subscriptions agents were reluctant to contribute to such a registry. In 2007, Cullen also found subscription agents reluctant to contribute subscriptions information to a central registry. A potential source of registry information in future may be SUNCAT, the UK Serials Union Catalogue. For SUNCAT to be useful in this way it should hold accurate and current information about e-journals subscriptions for any potential user of the registry-based resolver. At present, SUNCAT is not sufficiently comprehensive to take this role. The libraries contributing to the catalogue tend to be the larger libraries in the sector, i.e. the libraries that require and have link resolvers with full functionality. The licence registry solution has the same dependency as a KB-

based solution; it would be based on accurate, current information about the electronic 'holdings' of the libraries using the resolver. At present, it seems that only publishers have accurate information about the content of their e-journals packages and they are generally unable to provide it to either subscription agents or libraries. So, for now, it remains a challenge.

A solution based on a Rights Evaluation Scheme is currently available in the form of EDINA's GetCopy. As noted above, it cannot guarantee that a query will be resolved; It presents the user with a button which may or may not take that user to full text. The librarians that we interviewed find this solution unsatisfactory. A more functional service requires publisher co-operation and, as explained above, this is difficult to secure.

Of the three solutions considered in this study, the KB-based solution appears to be the most promising. A KB is an expensive database to develop and maintain. It may not be possible to develop a 'low-cost link resolver' but a reduced cost resolver which effectively addresses the specific needs of the UK market may be an attractive solution. Those organizations that currently offer KB-based solutions run businesses that are based on these data. It may not be viable to develop a KB for UKHE but it may be viable to licence data from an existing supplier and facilitate centralized, and possibly collaborative, customization so that it accurately reflects the UK-specific licences. (Serials Solutions was popular among interviewees as a provider of various services based on journals metadata. They may be one suitable provider of a KB and there may be others. Selection and negotiation would be a necessary part of any development project.) Whether a reduced cost solution offering the required functionality could be sustained by funding from the institutions that do not currently have link resolvers is unclear. Further work is required to scope the cost of the work and the projected take-up. Projected take up should take into account the HEIs without resolvers, any FEIS that may seek a low-cost solution and the possibility that some of the HEIs currently licensing other solutions may prefer one with a UK-focus and collaborative input from the community.

The OpenSource link resolver, GODOT, offered by Simon Fraser University is part of an integrated suite of products for locating and managing information resources called reSearcher (<http://researcher.sfu.ca:80/>). (The reSearcher suite also includes a serials management system (CUFTS), a federated search tool (dbWiz), and a bibliographic management tool (Citation Manager).) An initial inspection suggests that further exploration of these products as potential bases for a KB-based, reduced-cost solution for the UK HE/FE community is warranted. The link resolver has a human-usable and XML interface. It also uses technologies that the EDINA developers know to be both reliable and to scale effectively (Perl, mod_perl, Apache and Postesql). Nevertheless, like other KB-based solutions it is aimed at individual libraries, it requires an installation at each library and an expert librarian to configure the KB with local holdings information.

Three optional approaches may be considered.

- (1) A copy is installed at EDINA for each interested institution. Staff at the institution then configure for local use. Development work at EDINA would be minimized, but this solution would almost certainly not scale well to large numbers of institutions. An important role for EDINA in this scenario would be provision of a responsive helpdesk (effective support for 'problems' has been identified as an important criterion for librarians selecting a link resolver product).
- (2) EDINA installs and further develops the software to support multiple sets of subscriptions. This should scale well and be resilient whilst offering all of the functionality that librarians expect to find in a link resolver product. It would require substantial resource to develop and thus would not be 'low cost'. It is not clear whether, after development, it may be possible to offer this to institutions at a lower price than comparable commercial offerings. Clearly, there would be no profit so institutions would be contributing to cost-recovery rather than the profits of a commercial organization. However, the size of that contribution would depend on the number of institutions wishing to subscribe. Large commercial organizations provide service to a global market and thus can spread costs more widely than a solution developed exclusively for the UK market. The level of work at the institution would be similar to that invested for a commercial link resolver, i.e. the institution would be required to configure the KB with local holdings information. A central solution may reduce the burden on any single library as the UK-based deals (such as NESLi) could be configured collaboratively by all of the participating libraries.

- (3) EDINA could install a single copy of the software to disable/ignore issues of subscriptions. This would cost less than the fully functioning solution but would not address the appropriate copy problem; the issue of whether or not it could be resolved to a service that the user has authority to access would be left to chance.

A thorough evaluation is impossible without installation and testing of the software. Issues to consider would be: functionality; reliability; server load; effort required to configure; coverage of journal titles (and how well that fits with coverage in UK HE/FE libraries); coverage of services (e-journal packages and aggregations); accuracy with which it links to articles; how extensible is it; and how the user interface may be adapted (e.g. customizing to fit in with institutional branding and to comply with the relevant technical standards and UK accessibility requirements). This evaluation would occupy a software engineer for 3–4 months and require substantial input from senior librarian(s). As reSearcher is released under a GPL licence (<http://www.gnu.org/licenses/gpl.html>), any release of code would be subject to the same licence, i.e. it would be available free to anybody throughout the world to use as they wish. EDINA generally does not release code although JISC have sometimes required that EDINA provide code at the end of a project; this is effectively release and would necessitate the more general release required by GPL.

Library satisfaction with the link resolver products that they use

Many of the librarians that we interviewed are satisfied with the link resolvers that they have. One of the biggest problems is the lack of accurate and current information about NESLi2 licences. The librarians consulted by Cullen would love to have a centralised solution. Perhaps not surprisingly, vendors are less convinced by this proposal. Cullen, like the EDINA team that proposed the Licence Registry back in 2000, noted that subscription agents hold the key that could reduce workload in libraries and provide an accurate and effective KB-based solution. However, he reported that subscription agents are reluctant to release that information for such use. At present, the KBART Working Group is developing a programme of education and advocacy aimed at the stakeholders in the ‘knowledge base supply chain’ with a view to improving the experience of libraries. Until the information in a KB accurately reflects the UK-focused packages to which UK HEIs are subscribed, those UK libraries might benefit from collaborative configuration of a centralized KB.

8 Conclusions

The features that were identified by most respondents in this study as ‘essential’ indicate the baseline requirements for a link resolver in UK Higher Education. UK FE, it seems, has little need of a link resolver. The requirements identified as baseline for HEIs are, broadly, that the tool should interoperate effectively within the library’s suite of automated products; it should be straightforward and easy to configure and use; it should target all relevant content including aggregations; any problems should be addressed quickly and efficiently; it should not be necessary to duplicate work and time spent configuring holdings information should be minimised as far as possible. Libraries also expect the tool to keep pace with ongoing development in this field.

Most respondents to the questionnaire consider it desirable that the resolver they select already has a well-established user base within the UK. A number of reasons for this emerged in the interviews. First, it means that there are experienced users within the UK HE community who may be consulted during set-up. Several interviewees found the help of colleagues at other institutions to be invaluable. It also suggests that the resolver has been tried and tested at other institutions. Second, a high number of users in the UK increases the incentive for the vendor to develop and maintain the service with reference to UK needs (e.g. by reflecting UK requirements in the KB); the librarians interviewed also like the fact that when they report a bug, all the other institutions benefit too – it’s a collaborative enterprise. Third, a well-established user base suggests a high degree of acceptance, i.e. it’s a good tool. A fourth benefit associated with an established market, which was not mentioned by interviewees is that publishers are likely to prioritise delivery of accurate and current data to established providers. If the link resolver has a large user base, the publisher indirectly meets the needs of a larger proportion of its own users when it provides accurate data to the link resolver. That said, two interviewees who currently do not have resolvers but would like to have them said that they would trust a JISC-funded initiative and would expect take-up for such an initiative within the community to be high.

Nevertheless, a JISC-funded initiative would be new to the market at launch and so would have to address the lack of an established market. The organisation launching the resolver would be

required to satisfy institutions that it was very closely in touch with and would reflect their needs, for example, the NESLi2 deals would be accurately recorded in any KB if it were a KB-based solution, and implementation would be well supported. Very close association – perhaps a partnership - with the user community throughout development, testing and launch may go some way towards addressing this issue. This would provide user-focussed input into development as well as advocacy from within the user community.

It was clear also, in interview, and from respondents to the questionnaire, that librarians want a link resolver to surface all content as required by the user regardless of the format of the content and regardless of where it is held (i.e. in an e-journals collection, an aggregation or a subject-based database consisting of various formats and media types). A link resolver that targets only journal articles is still useful to many libraries but an emergent requirement is that it targets a much broader range of materials. Development of this functionality should be considered when developing the specification for any link resolver for the UK HE community.

Given the level of unmet need within the market and the level of functionality that is considered 'essential', a low-cost solution targeted at the smaller institutions in UKHE may not be viable. It may be that a UK-targeted solution would be viable only with widespread buy-in across the UKHE community. As institutions review their choices – at more or less frequent intervals – there is no reason why a good solution should not be taken up by institutions that currently have resolvers as long as it meets their core needs. . It may be necessary to develop a solution with good functionality that is not 'low cost' to develop but may be 'low cost' for individual institutions within the community due to the collaborative nature of the database customization. By sharing the effort of customizing the database to reflect UK-based licence deals (such as those negotiated by NESLi2), institutions using the tool may reduce their costs. Further work is required to determine the cost and projected income. It should be clear also that such a development should be undertaken by one organization (such as an NDC) with input from an expert in the community and that collaborative effort should be invested in customizing the database; this is not a recommendation for a collaboratively designed and developed initiative.

As with any product that requires investment in time from the library to select and implement, librarians want to know that the product has a future and that it will continue to be developed and maintained. This study is intended to explore the demand and feasibility for a JISC-funded solution. Any such solution would require some commitment to ongoing development over the medium term at least. Librarians do not wish to risk adopting a tool with an uncertain future.

9 Recommendation

We recommend that further work be undertaken to explore the feasibility of a centralised, collaborative UK-focussed link resolver based on a KB. We recommend that a specification for a link resolver, based on those outlined in this report and with input from the UK HE library community (e.g. through the JIBS User Group), be developed. The team undertaking this work should include not only technical staff but serials librarians with experience of KB-configuration and understanding of the NESLi2 licence packages. The development should be undertaken by an NDC; the requirements work should involve librarians, i.e. this would not be a collaborative specification and development. The following should be explored as part of this work:

- The suitability of the reSearcher solutions developed at the Simon Fraser University as the basis for this link resolver.
- The suitability of the GoldRush solution as the basis for the resolver.
- Assessment of the availability and comparison of the suitability of several candidate sources of data (e.g. the KBs of GoldRush, reSearcher, and one or more commercial offerings such as Serials Solutions.)
- The extent of the development work and ongoing maintenance work required to configure the selected KB for the UK community.
- The feasibility of a UK-wide consortium of HE libraries that might contribute to configuration and maintenance of the KB for a UK-focussed solution and a model whereby the effort might be shared by subscribing institutions.
- The cost of such a development and projected income based on likely take-up among institutions that currently have link resolvers as well as among those HEIs that do not and the larger FEIs.

- The likely impact on take-up within the community resulting from the perception that it has no guaranteed future (due to the fact that it is funded as a project).

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Appendix 1: Key to interviewees

To protect the anonymity of the interviewees, we have identified them as coming from institutions in three categories: Large, Medium and Small. Large institutions fall into JISC Bands A—C, Medium institutions fall into JISC Bands D—F, and Small institutions fall into JISC Bands G—J.

Interviewee number	Institution size	Link resolver information
Interviewee 1	Medium-sized HEI	Has purchased link resolver but has yet to implement
Interviewee 2	Medium sized FEI	Does not have a link resolver
Interviewee 3	Medium sized HEI	Has had a link resolver for 3 years.
Interviewee 4	Medium sized HEI	Implemented link resolver in 2005 but was unhappy with it

		so did not advertise to staff and students. Replaced this with current link resolver in July 2007 and is very happy with this solution.
Interviewee 5	Medium sized HEI	Has had link resolver since 2005.
Interviewee 6	Medium sized HEI	Does not currently have a link resolver but is in the process of selecting one.
Interviewee 7	Large HEI	Has had a link resolver for 3 years.
Interviewee 8	Large HEI	Has had a link resolver for 4—5 years but for the first few years was using a less functional product than at present which it did not promote or support. The current product was first implemented 1 year ago.
Interviewee 9	Medium sized HEI	Has had a link resolver (to article level) since January 2007; before that, for a single term, it had a tool that resolved to journal-title level.
Interviewee 10	Large HEI	Does not have a link resolver.
Interviewee 11	Small FEI	Does not have a link resolver.
Interviewee 12	Small HEI	Does not have a link resolver but intends to get one.
Interviewee 13	Small HEI	Does not have a link resolver but intends to get one.
Interviewee 14	Medium sized FEI	Does not have a link resolver and sees no need for one.

Appendix 2: Features and functions that were categorised into ‘essential’, ‘desirable’ or ‘not required’

Questionnaire on link resolver features and functionality for UK HE/FE

For each of the following features and functions of a link resolver, please indicate whether you consider it essential, desirable or not required:

CONFIGURATION AND TOOLS FOR LIBRARIAN

- It should Interoperate with other products that you use e.g. LMS, e-journal management system or services generating OpenURLs such as bibliographic databases.
- It can be customised with your own branding.
- It provides a facility for the library to customize the ‘help’ function.
- It is easy to activate titles, i.e. easy to discover titles in the Knowledgebase and activate them.
- It is easy to record and report problems.
- No specialist technical skills are required to configure and maintain the service.
- Local holdings information may be uploaded with a high degree of accuracy.
- It is easy to prevent local holdings information from being overwritten when the KnowledgeBase is updated.
- It offers a facility to link on e-ISSN
- It analyses overlap of content between different aggregations of content
- The Knowledgebase is sufficiently comprehensive and aligned with your holdings and is continuously updated.

THE USER EXPERIENCE AND CONTENT TARGETTED

- It resolves to titles in aggregator services as well as e-journals services.
- It resolves to content such as conference proceedings, theses and dissertations as well as journal articles
- It does not present users with a non-functioning link button for content to which you are not subscribed
- Over 95% of journals successfully link to article level.
- The interface is intuitive
- It resolves to papers in Open Access Repositories

FUNCTIONALITY WHEN NO E-JOURNAL ARTICLE AVAILABLE

- It directs users to your inter-library loan or document delivery services when no electronic copy is available.
- It automatically populates the ILL/DD request form.
- Local catalogue records are automatically loaded and displayed to the user when the print copy is the most 'appropriate copy'.

VENDOR OFFERING AND REPUTATION

- The vendor should have a good track record of responding to problems/issues.
- The vendor demonstrates a commitment to ongoing development.
- Vendor training should be conducted on a live system.
- The vendor offers training on the live system
- It is available as a hosted service.
- It is available for local installation.
- It already has a well-established customer base including libraries of a similar size to your own.

OTHER

- Other (please name)

Results of web-form questionnaire

Feature/function	Essential	Desirable	Not required
1 It should Interoperate with other products that you use e.g. LMS, e-journal management system or services generating OpenURLs such as bibliographic databases.	48	1	0
2 It can be customised with your own branding.	20	28	1
3 It provides a facility for the library to customize the 'help' function.	12	34	3
4 It is easy to activate titles, i.e. easy to discover titles in the Knowledgebase and activate them.	46	3	0
5 It is easy to record and report problems.	40	9	0
6 No specialist technical skills are required to configure and maintain the service.	15	33	1
7 Local holdings information may be uploaded with a high degree of accuracy.	40	8	1
8 It is easy to prevent local holdings information from being overwritten when the KnowledgeBase is updated.	42	5	1*
9 It offers a facility to link on e-ISSN.	24	23	1*
10 It analyses overlap of content between different aggregations of content.	10	38	1
11 The Knowledgebase is sufficiently comprehensive and aligned with your holdings and is continuously updated.	42	7	0
12 It resolves to titles in aggregator services as well as e-journals services.	39	9	1
13 It resolves to content such as conference proceedings, theses and dissertations as well as journal articles.	15	31	3
14 It does not present users with a non-functioning link button for content to which you are not subscribed.	36	11	2
15 Over 95% of journals successfully link to article level.	32	16	1
16 The interface is intuitive.	42	7	0
17 It resolves to papers in Open Access Repositories.	18	30	1
18 It directs users to your inter-library loan or document delivery services when no electronic copy is available.	19	28	2
19 It automatically populates the ILL/DD request form.	10	36	3
20 Local catalogue records are automatically loaded	23	22	4

and displayed to the user when the print copy is the most 'appropriate copy'.			
21 The vendor should have a good track record of responding to problems/issues.	43	6	0
22 The vendor demonstrates a commitment to ongoing development.	39	10	0
23 The vendor offers high-quality training.	24	24	1
24 Vendor training should be conducted on a live system.	9	35	5
25 It is available as a hosted service.	13	30	5*
26 It is available for local installation.	8	27	13*
27 It already has a well-established customer base including libraries of a similar size to your own.	9	35	5