Informatics Studies. ISSN 2320 – 530X. Vol. 4, Issue 3
Third Quarterly Issue. July – September, 2017. P 27-38

Library Discovery System: An Integrated Approach to Resource Discovery

Chetan Sudhakar Sonawane

Abstract

This paper provides an overview of Discovery tools that are the extension of the third generation library catalogues. The article discusses the features associated with both the open source and commercially available discovery system. The challenges associated with discovery systems are metadata challenges, adoption of standards, recommended practices, etc. The article points to the initiatives to address these challenges and others like comprehensive index coverage, creation of open access index and cooperation of discovery system agencies, standardization of vocabulary etc. Author concludes with the observation that there should be more open source solution in Discovery System so that the prices of the discovery systems controlled by commercial enterprises can be reduced.

Keywords: Discovery system, Google Custom Search; Central index, Web-Scale discovery, Discovery service; Federated Search.

Introduction

Discovery tools provide a single window approach to the segregated resources subscribed by the library. This includes the Online Public Access Catalogue (OPAC), e-resources subscribed by the library, Institutional repository, News papers articles repository, Open Access content and many more. Users of the library expect the library catalogue to function in a way Google functions. The set of available discovery tools are based on the central index which is relied on metadata, full text, or other type of representation of the content item in a library's collection on which the search result is based and these tools are often referred as 'web-scale discovery services'. The discovery layer provide an interface which enables the users to search and retrieve results based on the keywords entered for this purpose and allows to select the desired content. The results thus generated are based on relevancy, faceted navigation, and other features consistent with web-based resources. Some of the index based commercially available discovery tools include Primo and Primo central, EBSCO Discovery Service, Summon and World Cat Discovery. Open source discovery interface includes Blacklight, VuFind, eXtensible catalog and Franklin which are not based on any index-based discovery services and are not capable of searching in open access and the community created central index is not incorporated in it unlike the commercial discovery system named above.

Discovery services started appearing from 2009, they are also referred as 'web-scale discovery services'. The evolution of discovery services brought a revolution as it provides a combined ability to perform a search among the vast resources subscribed by the library (JoLinda, 2014). Discovery tools started appearing in libraries as a post development of next generation library catalogue. Federated Search engines were prevalent before the onset of Discovery System and were widely used. Discovery tools make the search in a unified index and it presents the results in a single window, on the other hand Federated search engine makes the search in a set of databases and aggregate the results. Commercial Discovery tools such as Summon, EBSCO Discovery Service, Primo and OCLC WorldCat are index based and WebFeat, EBSCO Integrated Search and Knimbus are examples of Federated search engines. Federated search engines displays results based on search algorithm and relevance ranking as well as each tool's algorithm and relevance ranking. Discovery tools are often misunderstood with that of federated search products[5]. But there is a considerable difference in their functionality and retrieval of results and due to this difference Discovery services has gained in popularity and has seen wide adoption in libraries due to the capacity of retrieving relevant results.

Commercially available discovery service providers have engaged into an agreement with e-journal database vendors, which allow them to pre-index item metadata and full text content which differs in search technique unlike the searches made in Federated search engine. This features of harvesting metadata and full text content results in retrieving results based on relevancy, which can again be sorted as per the convenience of the researcher viz. publication date, item type, full text only etc. The search result box resembles like that of Google, which provides in addition to simple search, additional search option and the search interface includes features like faceted browsing (Jason, 2012).

The different set of metadata standards of different resources housed by the libraries posed challenge as they differ in their metadata standards which in turn provides poor search result to the reader. With the advancement of Discovery services and other technologies the development of a common standard is necessary so as to have consistent access to all relevant library contents which include books, e-books, institutional repository and other resources available in electronic format. Discovery service providers have started working in partnership with ILS (Integrated Library System) vendors so as to re-index OPAC (Online Public Access Catalogue) holding and other electronic resources holding as mentioned above into a new single unified index (Heather Lea, 2015). This will turn all the resources subscribed by the libraries into a single common format, which will retrieve results based on relevancy upon a search query formulated by the user. There is an ambiguity regarding the indexing of the content and subsequently the retrieval of records in the discovery system. Unfortunately there is no standard among the discovery service providers to guide this process. (JoLinda, 2014).

Web Scale Discovery Services (WSDS)

The current genre of index based discovery services is marketed as Web Scale Discovery services (WSDS) which is dependent on a large central index populated by metadata, full text, or other representation of the content item in a library's collection. The central index representation differs in different commercial discovery service providers. The four commercial central index based web scale discovery service providers identified are: Primo and Primo Central from Ex Libris Group, EBSCO Discovery Service from EBSCO Information Service, Summon from ProQuest and WorldCat Discovery Services which was formerly WorldCat Local from OCLC- Online Computer Library

Centre. (ABES, 2016). These index based discovery services are evolving rapidly so as to keep pace with the increasing competition among the commercial discovery service providers to gain more customers. There has been continuous effort to increase the coverage of content in the indexes, to add new features to their end-user interfaces, and to improve the performance of the relevancy and other search and retrieval capabilities.

The amount of materials as part of the contents included is enormous. But the number of content included is not important and should not be the parameter to measure the completeness of the index, but it helps to demonstrate the magnitude of content that must be addressed. Not all of the providers of the commercial index-based discovery services mention the number of records indexed in the central index. ProQuest however declared for the first time on its website in January 2015 (Proquest, 2015) 'Summon: The Summon service is the only discovery service based on a unified index of content. More than 90 content types, 9,000 publishers, 1, 00,000 journals and periodicals, and 1 billion records are represented in the index. New content sources are added every week and content updated daily.'

A single record represents each unique resource, which merges records from different sources or providers for the same resource, in this fashion the index is designed in ProQuest Summon. This single record representation combines together citation, full-text, and A & I (Abstracting and Indexing) resources. Other products, such as EBSCO Discovery Service, maintain separate records from each source that represents any given resources. This difference in record strategy has many implications in the functionality of the index, but it also means that those that do not merge records may have substantially more than the 1 billion reported by ProQuest for Summon (Louise, 2014).

Types of Discovery Services

There are different types of Library Discovery System made available, which is categorized depending on the kind of library in which they are useful. The current discovery environment in the academic library arena is dominated by a set of products within the genre of index-based discovery services, which is also termed as 'web-scale discovery services'. There is another kind of Non-library discovery service which provide an option to index-based discovery service. It is the services provided by Google in the form of Google Scholar or Microsoft Academic search. They are services provided by library-oriented divsions of Google and Microsoft respectively. The discovery system designed for the use of public libraries is known as Public library discovery services, they are designed taking into consideration the issues faced by them, the discovery environment for the public library needs the ability to search local print collections, licensed e-book collections, modest collections of scholarly and popular electronic resources, as well as any local repositories of content. In addition to this there are some comprehensive library portals that include Discovery and Open Source Discovery interface software[4]. The different types of Discovery Services offered by different categories of libraries and the products offered by Discovery service vendors are discussed below along with an in depth feature analysis.

Index-based Discovery Services

Index based discovery services include a discovery interface, which provide a central index populated by resources that represent the general body of content of interest to libraries. The indexes covered are massive and its aim to include the entire academic library oriented content (or a specific subset of content, resources, and services available on the web).

The central index of Index based discovery services includes contents from following sources:

- Metadata and full text from commercial publishers
- Content from A & I resources
- Metadata and full text from open access repositories
- Metadata or full text from relevant Institutional Repositories (IRs)
- Bibliographic and holding information from a library's resource management system[4]

The current genre of index-based discovery services is entirely dominated by commercial products, which includes following products:

EBSCO Discovery Service (EDS)

EBSCO Discovery Service or EDS made its entry into the WSDS market in January 2010, in the wake of Serial Solution's (now ProQuest) vaunted release of Summon in the start of the year 2009. EBSCO had an experience of developing discovery services as a database provider. Libraries that were already receiving many of their databases and full-text content through EBSCOhost found advantage in using EDS. It also offered features to accommodate consortia customers. Catalogue configuration and Z39.50 connection to the library's ILS enabled EDS to pull in live status and location information for display in catalog records. EDS is offered exclusively as a cloud-based service hosted by EBSCO. Local repositories records can be loaded in any XML format that is OAI-PMH retrievable, including Dublin Core, EAD, METS, and MODS. In marketing EDS, EBSCO puts emphasis on its relevancy-ranking algorithm and its ability to draw from the subject indexing available on EBSCOhost. Application Programming Interface (API) of EDS allows integrating it with IR, Learning Management system (LMS) like Moodle, and other discovery interface. EDS mobile application optimizes search and display on most mobile platforms. Third party services like ChiliFresh (www.chilifresh.com) or GoodReads (www.goodreads.com) can be integrated for review and tagging services (Sharon, 2010).

Primo and Primo Central

Primo was first released in 2007 as a next generation catalogue product. Ex Libris which is also an ILS vendor developed it to serve as an enhanced catalog product for any ILS product. It was developed to serve as an enhanced catalog product for any ILS product, like its next generation OPAC competitors. Primo offers an integrated search interface for the catalog records and other local collections (Primo, 2016). In the year 2010, Ex Libris launched its web scale discovery component Primo Central; it is a managed central index of scholarly content. Primo uses Apache Lucene or SOLR as its technology for managing for local indexes (Marshal. 2014). Primo central index is a mega aggregation of hundreds of millions of scholarly e-resources of global and regional importance. These includes journal article, e-books, reviews, legal documents and many more that are harvested from primary and secondary publishers and aggregators, and from open access repositories. Primo central index is offered as an integral part of the Primo Discovery and Delivery solution, which allows the researcher one stop search service (Primo, 2016). Primo provides tagging and writing reviews feature for enriching the catalogue (Primo, 2016). The Primo central index provides search result of global e-content on article level during discovery via an open API. Primo has started link data initiatives in the beginning of the year 2016.

Summon

Summon is one of the early entrant into the library web scale discovery environment developed by ProQuest (originally developed by Serial solution a division of ProQuest[15]) and its first release was in July 2009. Summon is offered as a hosted software as a service solution[14]. Summon is based on a vast central databases of metadata and whenever possible full text content also.

The database design is a proprietary content, and it uses open source software namely Apache Lucene/SOLR as is used by other commercial index based service providers. It maintains separate record of each item, even after receiving the data in bulk containing numerous records of varying metadata from different sources. These records are matched and merged into a single entry within Summon whenever possible, so as to minimize duplication. Search results are ranked on relevancy, API is made available which can be used to host Summon services on in house or other open source discovery interface.(Primo, 2016). Summon is having consortia limitations.

WorldCat Discovery Service (formerly WorldCat Local)

WorldCat Discovery Service is managed and developed by OCLC. OCLC is a non-profit organization that is owned and governed by library community. Although OCLC has not devised an open access model in compare to index based discovery services offered by commercial enterprises. Access to WorldCat services is limited to member libraries with paid subscription[4]. OCLC's WorldCat can be seen as an early example of web-scale discovery. The pilot implementation of it began in 2007, and it provided access to global resource for discovery of books, and many databases had been loaded to provide at least some article-level material. WorldCat Discovery is the newest entrant into the discovery services market, and it was launched in the beginning of 2014, it is a cloud based application. OCLC is currently developing WorldCat API. If any other discovery service provider implements the API of OCLC, the license terms between OCLC and content provider do not allow for all centrally indexed content to be searched /redistributed to another user interface (ABES, 2016). WorldCat Discovery service displays holding location of resources that are geographically close. RSS feed, linked data, tagging, Reviews, Permalink, Cite/Export, Email, Share service is provided.

Non-library Discovery Service

Researchers do not always make use of the discovery service provided by the libraries, Google Scholar or Microsoft Academic Search is other alternative. Among the non-library scholarly discovery tool Google Scholar dominates. Google Scholar provides an index for scholarly material that is widely used by students of all ages and researchers. The scale and sophistication of technology used by Google far exceeds in comparison to that provided by library discovery system. Google does not provide information about its search algorithm; its operation completely differs from that of index based discovery system. The index for Google scholar is populated primarily through automated processes, unlike index based discovery services it does not depend on transfer of metadata from publishers, it employs harvesting robots for scholarly resources that differs from which it has employed for Google search engine, but it is likely that they will have synergies. These bots finds out scholarly materials metadata as well as full text and harvest it in Google Scholar index, likewise Google Scholar has also agreement with major publisher to index proprietary content. This agreement helps Google Scholar harvesting bots to access document within their secured server that would otherwise available only to authorized subscriber, the real time harvesting helps in making available recently added content immediately to users, unlike index based discovery services which needs to transfer metadata on a periodic basis (Jody Condit, 2014).

Public Library Discovery Service

The issues faced by Public libraries differs from that faced by academic libraries, the major part of academic library's collection resources include e-journals, whereas public libraries continue to be engaged with primarily with books – with e-books representing ever higher level of interest. The discovery environment for a public library

needs the ability to search local print collections, licensed e-book collections, modest collection of scholarly and popular electronic resources, as well as any local repositories of content.

In addition to academic and research libraries, the discovery service products are tailored according to the need. For Public libraries the product designed include, for example BiblioCommons and Aqua Browser. The modern day OPAC (Online Public Access Catalogue) are designed in such a way that it includes all the features of Discovery interface. The OPAC module although being part of ILS, have also started providing facility of integrating local index, faceted navigation and integration option with index based discovery services. For example ProPAC for Polaris, Encore from Innovative interfaces and the LS2 PAC from the Library Corporation (Arta, 2014).

Comprehensive Library Portal that Include Discovery

The Discovery services of an academic library are designed in addition to library's webpage. In case of Public libraries the discovery interface product includes not just resources, but also content management system and other functionality that provide a complete replacement for library website.

These products offer a seamless presentation that unites the discovery-oriented tasks with many other activities that are supported through website. They have the potential for making all of the descriptive information about the library's services and programmes, finding tools and other content in a library's website more accessible and discoverable to library users.

Some of the commercial products in this genre include (Sharon, 2010):

- Iguana from Infor Library solution
- Arena from Axiell
- BiblioCMS from BiblioCommons
- Enterprise from SirsiDynix (optional capability)

Open Source Discovery Interface

Open Source Discovery interface provides just the front end interface only, the tools includes:

Blacklight is originally developed by the University of Virginia, and is based on a Ruby on Rail programming framework and Apache SOLR indexing, search and retrieval technology. Blacklight provide a flexible toolkit for a wide variety of record type and is the predominant search interface to the Hydra project digital asset management.

VuFind is originally developed at Villanova University, is based on a PHP programming codebase and Apache SOLR indexing search and retrieval technology. VuFind has been implemented in thousands of libraries. Many of the project work with forks of the original codebase and the development effect can be characterized as independent and fragmented[4]. VuFind offers a number of advantages which includes single search functionality across multiple collections, relevant ranked result, customizable facets, export capabilities, content preview, and user generated content. VuFinb also provide advanced search facility (Danya, 2013).

eXtensible Catalogue (XC) is a research project launched in April 2006 by the River Campus libraries of the University of Rochester, the funding source of it was Andrew W Mellon foundation, that has created a number of tools that supports the development of discovery tools and services. The main outcomes of the project include a set of connectivity tool, including toolkit for the Open Access Initiative Protocol for Metadata Harvesting (OAI-PMH) and for NISO (National Information Standard Organisation) Circulation Interchange Protocol as well as XC metadata services toolkit. This toolkit offers utilities for the transformation and cleanup of metadata as it is extracted from repositories, such as library management system, and loaded into discovery services. The eXtensible catalogue project has also created the XC Drupal toolkit

that provide a discovery interface with customizable faceted navigation based on the content from library website and repositories. The Kyushu University Library in Japan has implemented a discovery interface for its local catalogue holding based on the XC Drupal toolkit of the XC. (http://catalog.lib.kyushu-u.ac.jp/en)

Franklin is a local discovery interface developed by the University of Pennsylvania Libraries, which is not based on Balcklight or VuFind (Dhanya, 2013).

4. Features of Library Discovery System

As we know the Discovery Interface provides access to a wide variety of resources made available by the library through a single search window. Even though in literature its many definitions are defined, the same is the case with the features of the library discovery system. But there is a consensus on the certain major features, such as central index (which denotes the metadata as well as full text content converted into a single unified index), the single search box, relevancy ranking, and facets (Jennifer, 2015).

End-user interface is the static HTML web page designed to enable searching by means of a web browser in order to provide access to a wide variety of resources made available by the libraries. The End-user interface provide access to simple search box and advanced search box in which the user can execute the query by entering the search expression. The advanced query let the user perform the search according to available criteria, the output is usually in the form of brief record or in full record display format, it all depends on the convenience of the users in which form the user want the search to display.

Interoperability with a link resolver which provide link to full text from citation record in search results.

Local search and retrieval, is usually performed by an integrated indexing, search and retrieval component to collection of interest. Many local search and retrieval indexes use Apache SOLR™ (Solr, 2016) or Elastic (Elastic Search, 2016) as the local search tool.

Ability to interactively communicate with the library's ILS implementations this is the most essential feature the library discovery system must provide in order to display the current availability status of items in the library's physical collection so as to place the request for holds or recalls, and interacting with the patron records to present current account status, list of items charged, fines or fees due, and to view or update personal details.

Access to remote index platform via API in addition to, or instead of search queries aimed at receiving results from a local index. A discovery index can also connect with the external platform that indexes content of interest. This kind of interoperability is made possible due to Application Programming Interface (API) which is a mutual agreement between the discovery service provider and the content provider, which manages the requests, responses, record transfer, and documentation presentation needed to support a search session (Jennifer 2016).

Metadata Challenges in Web-Scale Discovery Services (WSDS)

The ideal next-generation discovery system, should have the ability to ingest and manage metadata from a variety of sources is a prime criteria of paramount importance. In any ILS usually the metadata remain in a static form until and unless new records are added or deleted from the database, but in the case of next generation discovery system this should remain a continuous process by which the metadata should be transported from one environment to another and finally harvested and transformed on a regular intervals (Jennifer 2016). Discovery tools imports metadata into one index as mentioned above, apply one set of search algorithms to retrieve and rank results (Marshall, 2015).

ILS integration is one of the major factors to be considered while selecting a Discovery Service. Discovery service providers provide multitude of option for ILS integration[8]. The library catalogue has typically and traditionally provided access to only parts of the collection owned by the library system, such as physical collection of books, journals, DVD's, CD's and so forth. The bibliographic records for these collections are typically structured using standard library metadata system such as Anglo-American Cataloguing Rules (AACR), controlled vocabularies, normally Library of Congress Subject Heading (LCSH), and encoded within the Machine-Readable Cataloguing (MARC) framework. Depending upon the library material catalogued, the discovery system needs to negotiate different metadata standards, such as AACR, Rules for Description and Access (RDA), VRA (Virtual References Association) Core, the Metadata Encoding and Transmission Standard (METS), the Metadata Object Description Schema (MODS) and the Resource Description Framework (RDF), to name a few (Louise, 2016).

A typical library currently has metadata pertaining to its collection residing in a variety of separate online system: MARC data in an ILS, metadata in various schemas in digital collections and repositories, citation data in commercial databases, and other content on library websites. Repurposing MARC metadata from an existing ILS will be one of the biggest metadata tasks for a next generation discovery system[6]. The most important factor is that the ILS should allow metadata harvesting (Open Access Initiatives (OAI) / Protocol for Metadata Harvesting (PMH) compatible) or should have the feature of exporting MARC 21 metadata. OAI/PMH is the preferred method as periodic harvesting of metadata from ILS to discovery index is ensured without human intervention[8]. Using Web services and standards protocols such as OAI-PMH offers not only a short-term solution for reusing metadata from an ILS, but can also be used in both the short and long term to harvest metadata from any system that is OAI-PMH harvestable (Louise, 2016).

If the ILS system doesn't have OAI/PMH compatibility the option is to export the MARC 21 or MARC XML metadata and load into discovery system. Discovery providers usually provide an exclusive FTP (File Transfer Protocol) account for libraries to load their MARC records. FTP space basically consists of two folders viz. 'FULL Folder' for loading the full set of MARC records at the beginning and 'UPDATE Folder' for loading the new records or updated records periodically. Some ILS vendors help the libraries by including a script in the ILS system to perform a crone job to upload metadata into discovery FTP space whenever records are modified or new records are added in ILS system. Libraries can insist ILS vendors for providing such option. Catalogue integration is one of the major problems faced by the Indian libraries while implementing web scale discovery. Unfortunately none of the Indian libraries are having ILS with OAI/PMH compatibility. Some of the leading ILS vendors even don't have MARC 21 export facility or they are not willing to provide this facility to user, due to the fear that the user may move to Open Source ILS system once they get the MARC data.

Discovery system prefers Dublin Core metadata and it supports OAI/PMH standard with regard to Institutional Repository (IR). Some IRs may have different metadata schema and it may have non compatibility with OAI/PMH. In such a case Discovery service provider can harvest the records on a daily, weekly or monthly basis and can update the records in a Discovery Service. The harvested data will be uploaded into the Discovery system, after saving it into FTP folder as mentioned above. The prerequisite for this is the data must be in XML format, and it must have unique identifiers (Sharon, 2010).

Associated Standards and Recommended Practices

There is no uniform standard existing for the disparate resources made available by the libraries and hence it is very much difficult to develop a search mechanism dealing with resources that are vastly different in design[5]. The effort in the direction of standardizing the Discovery System in the form of creation of standards for the use of Discovery Systems community has been put forward by Marshall Breeding and associates by the initiation of Open Discovery Initiative (ODI). The ODI was initiated in June 2011 by Oren Beit-Arie of Ex Libris, Jenny Walker, an independent consultant working on behalf of Ex Libris, and Marshall Breeding, a library industry consultant (previously at Vanderbilt University) who, at the 2011 ALA Annual Conference in New Oreleans, invited senior industry professionals to discuss about the library discovery services issues. In the meeting a discussion was carried out and the proposal was submitted to National Information Standard Organization (NISO), as a consequence of this the NISO Discovery to Delivery Committee accepted the proposal as a new NISO work item. This recommended practice is the outcome of that project (Marshall, 2014).

The NISO ODI group started its work in early 2012 to define best practices for the new generation of library discovery services. These services functions by means of an aggregated central index to enable searching in a wide range of library related resources both licensed and free from multiple providers. Marshall Breeding of NISO has discussed in details every aspect relating to Discovery System including expanding field, various issues, and recommended practices, issues related to proprietary content and open access content, the integration of discovery services with resource management systems (which includes ILS and library services platforms) and with learning management system like Moodle, linked data as a future possibility, yet not recognized its potential. There are other challenge that needs to be addressed like comprehensive index coverage, creation of open access index and the problem arisen due to non cooperation on the part of A & I (Abstracting and Indexing) service providers(Heather Lea, 2015).

NISO Open Discovery Initiative (ODI)

The National Information Standard Organization (NISO) Open Discovery Initiative (ODI) Working Group (www.niso.org/workrooms/odi) developed a recommended practices document for *Promoting Transparency in Discovery* that has been approved by the Discovery to Delivery Topic Committee and published as NISO RP-19-2014. The ODI standard provides guidelines to the content providers on the disclosure of the level of participation, the minimum set of metadata element required for indexing, linking practices and linking formats. NISO ODI recommends address content listings, linking practices, file formats and method of transfer to be supported, and usage statistics for discovery service providers. The above link provides the guideline to the Recommended Practice.

NFAIS Recommended Practices: Discovery Services

The National Federation of Advanced Information Service *Recommended Practices: Discovery Services* was published in August 2013 (NFAIS, 2013). It addresses the interest of the providers of Abstracting and Indexing (A & I) services, the recommended practices highlights the specific issues and concern that apply to their potential cooperation with discovery services. The above link gives description about background of the discovery services environment and proceeds to outline concerns and issues that relate to how discovery services handle content from resources such as A & I products. The recommended practices mentions about the

right and obligation that imposes upon five categories of stakeholders: content owners, content platforms, discovery services, Subscriber of content resources, and end users. A matrix describes about the rights and obligation that apply to the specific component or activities within the discovery ecosystem relative to each stakeholder. The Description and Rationale part provides 18 guidelines that describe the recommended practices that apply to how discovery services needs to handle the content resources so as to satisfy the concerns of all the stakeholders' categories.

This set of practices was given careful attention by the NISO ODI Working group, as it mentioned about the A & I resources, as because the publisher of such resources are skeptical about providing their data to Discovery Service Providers.

Discovery: A Metadata Ecology for UK Education and Research

The Discovery initiative in the United Kingdom was active between 2011 and 2012, Jisc funded the programme with the intent to improve discovery of resources through the improved metadata practices (Discovery, 2016). The participants were a number of organization including Jisc, Mimas, Research Libraries UK, Eduserv, Collections Trust, and Sero consulting. One of the outcomes of the project was the development of a set of 'Discovery Open Metadata Principles' that define practices which aim to improve the discoverability of resources through improved metadata creation and dissemination. The above mentioned website does not mention any activity carries out after the end of 2012.

Other Standards

Excluding the above mentioned practices recommended by the ODI, there exist a few formal standards that apply in the various facets of library resource discovery. Several protocols or standards can be used in specific aspect of the discovery ecosystem:

OAI-PMH or ResourceSync (ANSI/ NISO Z39.99-2014) facilitates the transfer from content providers to discovery service providers. Along with these protocols, the transfer of data also takes place by other means like file transfer, web harvesting, or other mechanism which is decided between the Discovery service provider and host institution.

KBART (Knowledge Bases and Related Tools, NISO RP-9-2014) and related standard can be employed to help in defining structure of the metadata transferred from content provider to discovery services.

Indexing and Relevancy is accomplished through completely proprietary methods which is trade secret. Some of the discovery service providers make use of the open source tool such as Apache SOLR, the specific implementation and tuning are not provided openly. Although some generalized information may be provided regarding how relevancy is calculated, but they do not provide detailed factor and method.

Application Programming Interfaces (APIs) of different varieties are involved in the discovery services ecosystem, but there has been little progress achieved in reaching commonality. Discovery system needs the ability to interact with resource management systems for events such as shelf position and availability for loan, for the users account features, and resource request. These tasks are generally completed through a combination of library-oriented protocols such as SIP 2 or NCIP and proprietary APIs specific to each resource management system. These components are assembled into connectors which can be reused across implementations of each resource management system and discovery service. In case where discovery service and resource management system are developed by same vendor, these interaction can be conducted by proprietary mechanism.

There is a lack of standardization regarding the interaction between an index based discovery service and discovery interface. Each of the commercial discovery service providers offers an API that can be used to used to connect with the third-party discovery interfaces; each of the API differs substantially (Jason, 2012) .

Limitations

There are some limitations associated with Library Discovery System, in spite of the power and relative ease of use associated with discovery tools, until all content provider cooperate in sharing information about their content, there will be things that a discovery tool will not be able to access. It might happen that some databases subscribed by the library won't work with some discovery tools. In such a case the researcher should be made aware of the situation and should be advised to perform a search inside the database. Another major problem associated with Discovery system is that many databases utilize their own specialized vocabularies for providing subject access to the material that they include. Since the discovery tool in essence 'merges' many databases into one, the researcher should be aware that some databases might describe a specific topic in one way while another database might use the same term in different way. For example, the term *imagery* will be used in a different manner in a literature database than it will in a Psychology database. Therefore a researcher will need to use a better description in a search for articles on *imagery* in T.S.Elliot's poetry so that there aren't so many mismatches that turn up articles from discipline other than literature[19]. Unlike Google which do searching in full content and instead on not just in metadata as in Library Discovery system the search effectiveness is difficult to achieve.

Conclusion

The index based discovery services are continued to evolve in a highly competitive commercial arena. Each of the product have seen a continual advancement in their product life cycle to expand the content represented in their indexes, to add feature to their end user interfaces, and to improve the performance of their relevancy or other search and retrieval capabilities. To date no open source index-based discovery services have been created based on an open access or community created central index. In many other technological areas of library products open source alternative is available. Due to the availability of open source products which has provided an option of interest to many libraries to enable more customized solution to the problem at hand, but they also force the pressure on commercial enterprises to reduce prices. The availability of open source solution impacts the prices of commercial vendors. While the implementation cost of open source software must be taken into consideration as it needs a lot of expertise on the part of library which want to implement it or they need to depend on external service provide for implementing it.

References

ABES Discovery Study Appendix B Exploration of existing discovery system. http://www.abes.fr/content/download/2690/11332/version/1/file/Appendix+B+Exploration+of+the+existing+web+scale+discovery+services++Primo,+ED,+Summon,+WorldCat+Local+and+Google+Scholar.pdf . Accessed on 15.12.2016.

Bowen Jennifer, Metadata to support Next-Generation Library Resource Discovery: Lessons from the eXtensible Catalog, Phase 1. http://ejournals.bc.edu/ojs/index.php/ital/article/view/3253/2866.Accessed on 14.12.2016

Breeding Marshall, Library Resource Discovery Products: Context, Library perspectives, and Vendor positions, Library Technology Reports, 2014, 5-32. https://journals.ala.org/ltr/article/view/5779/7236. Accessed on 15.12.2016

Breeding Marshall, Open Discovery Initiative Working Group, Open Discovery Initiative: Promoting Transparency in Discovery. http://

www.niso.org/apps/group_public/download.php/14820/rp-19-2014_ODI.pdf . Accessed on 21.12.2016

Breeding Marshall, The Future of Library Resource Discovery, February 2015. Available at http://www.niso.org/apps/group_public/download.php/14487/future_library_resource_discovery.pdf . Accessed on 17.12.2016

Dartmouth college library, An evaluation of serial solution summon, Available at https://www.dartmouth.edu/~library/admin/docs/Summon_Report.pdf .Accessed on 4 September 2016.

Discovery (2016) (http://discovery.ac.uk/) Accessed on 04.02.2016

Discovery Tools. http://digitalcommons.unf.edu/cgi/viewcontent.cgi?article=1014HYPERLINK . 'http://digitalcommons.unf.edu/cgi/view content. cgi?article=1014&context =bliss'& HYPERLINK . 'http://digitalcommons.unf.edu/cgi/viewcontent.cgi? article=1014 &context=bliss'context=bliss . Accessed on 5 September 2016.

Elasticsearch (2016).) (www.elastic.co). Accessed on 4.9.2016

Fagan Jody Condit, Mandernach Meris, Nelson Carl S, Paulo Jonathan R and Saunders Grover, Usability Test Results for a Discovery Tool in an Academic Library, Information Technologies and Libraries, 2012, p 83-112. https://ejournals.bc.edu/ojs/index.php/ital/article/viewFile/1855/1745. Accessed on 15.02.2014

Kabashi Arta, Peterson Christin and Prather Tim, Discovery Services: A white paper for the Texas state library and archive commission, 2014. https://www.tsl.texas.gov/sites/default/files/public/tslac/lot/TSLAC_WP_discovery__final_TSLAC_20140912.pdf. Accessed on 15.12.2016

Leebaw Danya, Conlan Brian, Gonnerman Casia, Johnston Sarah and Sinkler-Miller Christina, Improving Library Resource Discovery: Exploring the possibilities of VuFind and Web-scale Discovery, Journal of Web Librarianship, 7(2), 2013, 154-189. http://www.tandfonline.com/doi/abs/10.1080/19322909.2013.785825 . Accessed on 18.12.2016

Moulaison Heather Lea, Kroeger Angela and Corrado Edward M, What's Driving Discovery Systems? The Case for Standards, IFLA WLIC 2015, Cape Town, 2015. http://library.ifla.org/1300/1/166-moulaison-en.pdf. Accessed on 15.12.2016

Narayanan Nikesh and Mukundan Ramina, Choice of Discovery: Evaluating web scale discovery services. Available at https://www.researchgate.net/publication/281810761_Choice_of_Discovery_Evaluating_Web_Scale_Discovery_Services . Accessed on 11.12.2016

Narayanan Nikesh, Implementing Web Scale Discovery Services: special reference to Indian Libraries context. Available at https://www.researchgate.net/publication/281814697_Implementing_Web_Scale_Discovery_Services_special_reference_to_Indian_Libraries'_context. Accessed on 15.12.2016

National Federation of Abstracting and Information Services (NFAIS) (2016). (https://nfais.memberclicks.net/assets/docs/BestPractices/ recommended_ practices_final_aug_2013.pdf. Accessed on 15.12.2016

Primo Central Index. Available at http://www.exlibrisgroup.com/category/PrimoCentral. Accessed on 4.9. 2016)

ProQuest, Serial solution takes the ProQuest name. Available at http://www.proquest.com/blog/2014/serials-solutions-takes-the-proquest-name.html (Accessed on 4 . 9. 2016)

Solr Public Server (2016). http://lucene.apache.org/solr. Accessed on 10.02.2016

Spiteri Louise F, Managing metadata in web-scale discovery system, (Facet Publishing), 2016, p 1-9.

Thompson JoLinda, Implementing Web-Scale Discovery Services: A Practical Guide for Librarians, (Rowman & Littlefield, Maryland), 2014, p 27-28.

Vaughan Jason, Investigations into Library Web scale Discovery Services, 2012. http://ejournals.bc.edu/ojs/index.php/ital/article/view/1916/1744 . Accessed on 15.10.2015

Yang Sharon Q and Wagner Kurt, Evaluating and comparing discovery tools: how close are we towards next generation catalog?, 2010. https://faculty.washington.edu/rmjost/Readings/evaluating_and_comparing_discovery_tools.pdf . Accessed on 04.10.2016