Developing an Alternative Approach for Interoperability Testing of Library Z39.50 Servers

A Request for an Extension

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Introduction

In our December 31, 2003 interim status report on the Z39.50 Interoperability Testbed Project (Z-Interop) [available at: http://www.unt.edu/zinterop/Documents/InterimReport31Dec2003.pdf], we highlighted the challenges of individual libraries to participate in the Z-Interop testbed. Attachment A contains two sections from the interim report that discusses in more detail these challenges. Most libraries only have a production system for their integrated library system and online catalog; they do not have a testing environment where they can load the Z-Interop test dataset of 400,000 MARC records, index those records separately from the production bibliographic database, and have that available for interoperability testing. The approach of the Z-Interop Project worked well for the vendors; they were able to set up a separate implementation of their Z39.50 server and online catalog products, prepare it for testing, and have the Z-Interop Project conduct interoperability testing.

In the interim report, we suggested an alternative method for interoperability testing for Z39.50 servers that could accommodate these limitations of individual library systems. The idea for this approach came from Sebastian Hammer, a principal in Index Data that is a company specializing in Z39.50 and networked information retrieval. The alternative method will use a small set of very special MARC records (we refer to these as "radioactive MARC records," explained below) that can serve as diagnostic mechanisms for assessing system functionality, performance, and interoperability. We think this alternative approach has potential for providing interoperability testing services to individual libraries. In addition, this approach may be adaptable to other protocol and metadata contexts beyond Z39.50 and MARC.

This document describes a plan of work to develop and test this alternative approach for interoperability testing. We request an extension to the existing National Leadership Grant through February 2005 to support this work. The resources needed to carry out the work are estimated at $49,521. This approach builds on the conceptual and technical infrastructure developed during the Z-Interop Project [information on the project available on the project website at: http://www.unt.edu/zinterop/].

Brief Overview of the Approach

The idea for a radioactive MARC record is based on current medical diagnostic techniques for people. When a person has a particular medical condition, there may be two approaches for diagnosis. One could be considered invasive, where the person would undergo a surgical technique for physically examination of the problematic area or anomaly. The other approach could be considered less invasive, where the patient is injected with a dye, possibly radioactive, and once it has spread throughout the body, scanning techniques allow a medical professional to identify structural or mechanical problems or anomalies.
A "radioactive" MARC record approach for interoperability testing would be less "invasive" for an individual library. It would not require loading a large test dataset such as used in the Z-Interop Project. Nor would it require a separate testing environment on the local implementation. Instead, the library

would load into its production online catalog system a set of diagnostic radioactive MARC records, and the Z-Interop Project staff would then conduct a series of tests to assess system functionality, performance, and interoperability. The radioactive MARC records will be legitimate instances of MARC records that a library system should be able to import and process, but the records will have very special characteristics.

The data in the MARC fields/subfields will consist of specific patterns of character strings (see below for more details about these records and their data). MARC records will be created for each of the various formats of bibliographic materials (e.g., monographs, electronic resources, cartographic materials, etc.) using the full set of MARC content designation available for each format. Instead of hundreds of thousands MARC records to load into a system, a small set of these "radioactive" records, maybe less than 20, would provide the basis for interoperability testing.
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Once the records are loaded into a library's online catalog system, Z-Interop Project staff will use a set of test searches and other processes to "find" these radioactive records under various search criteria. Test searches will be sent to the library catalog, and the results would be analyzed. In this scenario, instead of hundreds of records being returned, successfully interoperating systems would return the appropriate MARC diagnostic record for each test search. At the end of interoperability testing, the local library can easily remove the diagnostic MARC records from its production system.

Conceptually, this alternative approach for interoperability testing with library catalogs complements the approach of the Z-Interop Project's original testbed methodology and builds upon the technical infrastructure and understanding produced in the project so far. Research and development, however, will be needed to create these special "radioactive" MARC records, develop the test scenarios, and develop analysis procedures to ensure that the diagnosis of indexing or other structural or mechanical problems affecting interoperability was reliable. The technical and software infrastructure that resulted from the Z-Interop Project can be re-used in this approach for interoperability testing. Further, a "radioactive" record approach might easily be adapted for use with other protocol environments (e.g., the new Search and Retrieve for the Web (SRW) and Open Archives Protocol for Metadata Harvesting), and also adapted to other metadata environments. It is easy to imagine Dublin Core radioactive records or such records for other metadata communities.

Description of Work

The work for developing and testing the radioactive MARC records approach for interoperability testing will involve a number of separate activities:

- **Develop a framework for interoperability testing:** This will provide the conceptual framework for the approach. In this activity, we will identify more specifically the components of the testing environment. A preliminary list of the components include:

    - A set of radioactive MARC records
    - A mechanism for local libraries to access and load these special MARC records
    - Testing procedures to examine Z39.50 and online catalog search functionality, indexing policies, etc. as a method for assessing interoperability
    - Methods to analyze the data produced by the testing procedures
    - Output of the testing in the form of reports

    During this period, the Z-Interop Project staff will identify all tests that will be carried out (e.g., tests to determine search functionality, indexing policies, etc.) since these tests will inform the specific data to be put into the radioactive MARC records.

- **Creating the MARC records:** A set of special, diagnostic MARC records will be developed. The records will have special data recorded in fields/subfields. The exact nature of the data in these MARC records will be determined during the research phase of the work. We anticipate at least one MARC record for each of the following formats of materials:

    - Books, Pamphlets, and Printed Sheets
    - Cartographic Materials
    - Electronic Resources
    - Continuing Resources
    - Manuscripts (including manuscript collections)
    - Music (Notated and manuscript music)
    - Sound Recordings (musical and non-musical)
    - Motion pictures and video-recordings (including digital and non-digital)
    - Graphic materials (includes mixed materials, with or without archival control)
    - Three Dimensional Artifacts and Realia

  Multiple records for each format may be necessary to provide adequate coverage for the anticipated interoperability tests.

  The MARC records will use the fields/subfields appropriate to each of these formats (since some MARC fields/subfields only apply to specific formats of materials). In each of the records, there will be patterns of alpha/numeric characters encoded in appropriate fields/subfields. For example, the 245$a (title information) for two records might look like the following:

  245 $a**Xysos sifys asdsai-aduus**
  245 $a**Yszaqs sifys asdsai-aduus**

  A title keyword search with the search term “sifys” should retrieve both of these records. A title exact match for the term “Xysos sifys asdsai-aduus” should only retrieve the first record.

  Since the MARC record is very rich in its encoding potential, developing distinct data (patterns of characters) for each of the possibly hundreds of fields will be a major challenge. But the resulting radioactive MARC records will be incredibly powerful in assessing online catalog functionality, indexing practices, and Z39.50 server behavior. Attachment B contains a sample of a MARC record that represents the concept we are proposing.

- **Developing Testing Procedures and Scripts:** The interoperability tests that will be conducted will inform the data to include in the radioactive MARC records. Test searches will be created to ensure that various conditions for interoperability are assessed. One starting point for the test searches will be the specifications defined by the U.S. National Z39.50 Profile for Library Applications and the Bath Profile. The profiles define a number search types that vendors’ system claiming support of the profile should be able to process. The search definitions in the profiles specify both the Z39.50 data that should be processed as well as expected behavior of the online catalog implementation. In addition, there may be additional automated scripts that will be developed to assess server functionality, etc.

  We will focus on producing automated procedures and scripts to the extent possible, minimizing the human resource needed to carry out the testing and the analysis of results. The plan is to develop a simple toolkit that provides the testing functions required and programs or scripts to implement the testing procedures. Software tools produced for the testing will be released as open source software releases under the GNU General Public License (GPL). This will enable anyone to use the software.

- **Further Development of Indexing Guidelines:** The Z-Interop indexing guidelines were developed to accommodate a specific set of interoperability test searches. Additional work on the indexing guidelines will be carried out to develop appropriate guidelines for libraries to use when

setting up indexing policies for improved interoperability. Currently, the indexing guidelines address author, title, and subject keyword indexes. The guidelines will be expanded to address other searches defined in the U.S. National and Bath Z39.50 profiles.

- **Verifying Procedures through the Z-Interop Reference Implementation:** Once the MARC records have been created and the testing procedures developed, we will load the radioactive MARC records into the Z-Interop reference implementation server and online catalog (using SIRSI's Unicorn integrated library system). We will verify all procedures to ensure desired results are produced using the reference implementation. We will also develop mechanisms and documents for reporting results of interoperability testing.

- **Testing with Individual Libraries:** Upon completion of the development, testing, and verification of our interoperability testing using the radioactive MARC records and testing procedures, we will invite a number of libraries to serve as interoperability testing participants. We will set up the methods for the libraries to access the radioactive MARC records and load them into their systems. We will then conduct interoperability testing on the libraries' systems. Individual libraries will receive reports based on the interoperability testing. Feedback from these initial tests may require refinement of the MARC records and/or the testing procedures. We will do this iteratively with a small number of individual libraries to finalize all testing and reporting procedures.

Project Deliverables

The project will have a number of products as a result of this research, including:

- Framework for interoperability testing using radioactive MARC records
- A set of very specialized MARC diagnostic (i.e., radioactive) records; initial estimate is approximately 20 records; these will be publicly and freely available
- Documented and verified interoperability testing procedures and automatic processes for testing and analysis; any resulting software will be made available as open source software under the GPL
- Expanded guidelines for indexing policies for online catalogs
- Interoperability testing with 3-5 individual libraries.

Project Benefits

The initial Z-Interop Project developed methods and procedures, and built a technical infrastructure for Z39.50 interoperability testing. This approach worked well for interoperability testing with vendors of Z39.50 servers and online catalog products. The research and development effort proposed here for an alternative approach to interoperability testing complements and builds on the solid technical and conceptual foundation of our earlier work. We will leverage the initial IMLS funding for the Z-Interop Project to develop and test this alternative approach. The goal of this work is to make it possible for individual libraries to assess the level of interoperability their Z39.50 and online catalog implementations. The products of the proposed research will reduce the barriers for interoperability testing for these libraries.

Individual libraries will be able to understand how their choices for configuring their Z39.50 server and online catalog (e.g., indexing policies) enhance or detract from interoperability with other systems. We will provide reports to the libraries that go through the testing to help them determine the changes that can be made to their systems that positively affect interoperability.

Further, this innovative approach for interoperability testing may find a number of uses outside of the Z39.50 context. For example, a new initiative called Search and Retrieve for the Web (SRW) is developing the technology for information retrieval in a web services context. Some of the early

implementations are providing SRW services to search library catalogs. The methods and MARC records developed in this research should be able to be adapted to a SRW context.

Project Budget

For the work we have described, we are requesting IMLS funding in the amount of approximately $49,531. The primary expense is to support personnel working on the project and a subcontract to Index Data for assistance on developing the MARC records and the test scripts. The other major cost component is the University of North Texas' indirect costs. The following table lists a preliminary breakdown of costs. [not included in this version]

Dr. Moen, as Principal Investigator, will oversee the work. He will devote approximately 20% of his time on the project from March 1 through May 31, 2004, and 10% of his time from September 1, 2004 through February 28, 2005. There is no cost to IMLS for these periods of effort. Partial summer salary for 2004 will be supported by IMLS funds.

The two research assistants will be graduate students in the School of Library and Information Sciences. One will be a student who is knowledgeable about MARC and catalog records. The other will be a student who is knowledgeable about Z39.50 and testing. Both have worked on the Z-Interop Project.

Index Data is a software developing and consulting firm in Copenhagen, Denmark. Index Data is a premier provider of Z39.50 software and toolkits. Sebastian Hammer, a principal in Index Data, originated the idea of a radioactive MARC record approach to interoperability testing. He has confirmed his interest in working on this project.

The supplemental funds requested from IMLS will provide sufficient resources to carry out the work described in this request for extension.

Conclusion

The problems of semantic interoperability, as noted in the interim progress report, are the result of a complex of factors. The Z-Interop Project has made good progress in understanding and addressing a number of these factors. We produced a testing environment to assess levels of interoperability. The research and development we are proposing to carry out with the additional resources and time will focus on a method to make it possible for individual libraries to undergo Z39.50 interoperability testing.

Attachment A: Sections from the Z-Interop Project Interim Status Report

Note: Included here are two relevant sections from the report. The complete interim status report is available at: http://www.unt.edu/zinterop/Documents/InterimReport31Dec2003.pdf

6.2 Participation and Use of the Interoperability Testbed

The Z-Interop Z39.50 Interoperability Testbed was the first formal testbed for assessing Z39.50 semantic interoperability. A testbed sponsored by the Coalition for Networked Information in the early 1990s focused primarily on mechanical protocol-level interoperability at an early stage of Z39.50 implementation. The goal of the Z-Interop testbed was to improve semantic interoperability, a challenge that went far beyond the issues of protocol compliance (although that was a necessary condition to achieve to be able to assess semantic interoperability).

While there are hundreds, if not thousands, of Z39.50 client and server implementations in libraries in the U.S. and internationally, most of these local implementations are using products from a small number of library automation and other companies. The testbed was open to both vendors and libraries (see the Appendix F, Call for Participation). Participation in the testbed, was for the most part, by vendors rather than individual libraries.

At the time this final report for the Z-Interop Project is being written (although the official end of the project was September 30, 2003) a total of eight participants representing nine separate products went through (or are in the process of) interoperability testing. The following indicates the number of participants testing Z39.50 server and Z39.50 client products:

Z39.50 Server Products/Implementations
- InQuirion
- OCLC
- Dynix
- Horizon
- Innovative Interfaces Incorporated
- Follett
- Telus

Z39.50 Client Products
- Fretwell-Downing
- Saskatchewan Provincial Library (using Blue Angel Technologies Product)

Sirsi, Inc. contributed its Z39.50 server product to the Z-Interop Project, and by default was a participant in the testbed.

The list of companies with Z39.50 server products that went through the Z-Interop testbed covers much of the installed base of library automation systems in the U.S. There are several companies, however, that have Z39.50 server implementation in libraries in the U.S. that did not participate, notably, Endeavor Information Systems, The Library Corporation, Ex Libris, Gaylord, and Sagebrush. The Principal Investigator made contact with all of these companies to ensure they knew about the testbed.

The Principal Investigator had assumed at the time of submitting the proposal that individual libraries would be interested in submitting their Z39.50 server implementations to interoperability testing. This assumption proved incorrect for two primary reasons. First, the size of the test dataset (over 400,000 records) was too large to be accommodated by individual libraries. Second, most individual libraries' Z39.50 implementations did not include a test environment in which the test dataset could be loaded and indexed separately from the production bibliographic database of the individual library. This made it impossible for most libraries to participate in the testbed. As part of a project the Principal Investigator carried out in 2002 for the Illinois State Library, these barriers to participation became clear. The Illinois State Library encouraged the Illinois Regional Library Systems that hosted large shared bibliographic

systems to go through the interoperability testbed to improve statewide resource discovery and sharing. Yet, even with encouragement and support by the Illinois State Library, the Regionals were not able to go through the testbed for the reasons listed above.

Use of the testbed, however, was not limited to only those eight organizations that formally submitted their products for interoperability testing. During 2002 and 2003, as part of a Texas virtual library initiative, the Z-Interop testbed was used for assessing proof-of-concept applications for metasearching (i.e., cross database searching via Z39.50 and other protocols from a single search interface), and for technical assessment of responses to a formal Request For Proposal (RFP) by the Texas State Library and Archives Commission for a metasearch application for the Library of Texas (LOT) Resource Discovery Service. The Principal Investigator was involved in the design and development of the LOT Resource Discovery Service, and offered the interoperability testbed as a formal mechanism to assist the Texas State Library and Archives Commission to 1) assess the extent to which proof-of-concept metasearch applications conformed to the specifications for searching as defined in the Bath and U.S. National Z39.50 profiles; and 2) assess the technical conformance to specifications included in the RFP to procure a metasearch application for the LOT. The results of both sets of assessments provided information to the Texas State Library and Archives Commission as to the conformance to standards and profile specifications of Z39.50 client implementations integrated into a metasearch application. The results of these assessments were for internal use by the Texas State Library and Archives Commission, but for additional information about the Library of Texas design and the role of Z39.50 and interoperability see Moen and Murray, 2002.

8.2 The Future of Interoperability Testbed

As noted in previous sections, the Principal Investigator assumed incorrectly that individual libraries would be interested and able to participate in interoperability testing with their local implementations. The approach of the Z-Interop Project was to use a large test dataset to provide a more real-world exercise for systems and interoperability testing. Yet, it was precisely this large dataset that presented a barrier to individual libraries' participation, along with the fact that most libraries' local systems do not have test environments in which to load this or any other test dataset. To address the issue of the size of the test dataset, the Z-Interop staff developed a 100,000 record subset of the Z-Interop test dataset, and during the last period of the project, the staff began to redo test searches and benchmarks using this smaller dataset. However, individual library participation would still be limited by the lack of test environments available in local systems.

The Principal Investigator had also assumed a business model could be developed to provide a sustained revenue stream to continue and expand the Z39.50 interoperability testbed. This assumption was based on the incorrect assumption about individual library participation. Since there are a very limited number of vendors that produce Z39.50 products for the library market (and many of those went through the Z-Interop testbed), there is not a broad market of vendors to sustain the interoperability testbed as it is currently configured and operated.

However, in the last two months of the project, the Principal Investigator discussed this issue with Sebastian Hammer, a principal in Index Data, a premier company that develops Z39.50 server and client toolkits and source code. Hammer suggested that what is needed is a "radioactive" MARC record (or a limited number of such records) through which the types of interoperability assessments done in the Z-Interop testbed could be carried out without putting a burden on the libraries' local system implementations. This idea will be discussed in Section 9.3 A Radioactive MARC Record for Interoperability Testing.

A "radioactive" record approach for interoperability testing does not invalidate the work accomplished in the Z-Interop Project. All of the ground-breaking work in data analysis, testing procedures, test searches, and identification of continuing interoperability challenges would inform this alternative approach for interoperability testing.

Attachment B: Sample Radioactive MARC Record

The following is based on a real MARC record but the data have been changed to special patterns of characters. This is only meant as an example, and the actual radioactive MARC records developed as part of this project may include much more detailed encoding and data.

```
100 1  Yzllsnusn, Bxsofaz Z.
245 10 Oyjiaksxxs :|bp eislyacxz qossasumc /|cby
       Bxsofaz Z. Yzllsnusn.
250    3rd ed.
260    Mpzsial, ZZ :|bBzysifs wqaspo ;|aNwausa, XX :|bIbxnsaa,
       |c[2200]
300    [8] p. :|bill. ;|c22 cm.
500    Oxsuasyatq mosaustxas.
610 20 Pszuasquyatoansua dasuysaytqrew.
       |tIqsatpmcjsa msiayqwd amxsaing tysiasdaq.
650  0 Nsasqyasda|xYzuawqgtts|zMmmmm Stazqst.
650  0 Msiass-Sasdasmn usyza wusasdas|xYzuawqgtts|zMmmmm Stazqst.
650  0 Aqstsacsst|xYzuawqgtts|zMmmmm Stazqst.
650  0 Vcsatysaw paisqdfdat msuawwmea|xYzuawqgtts
       |zMmmmm Stazqst.
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