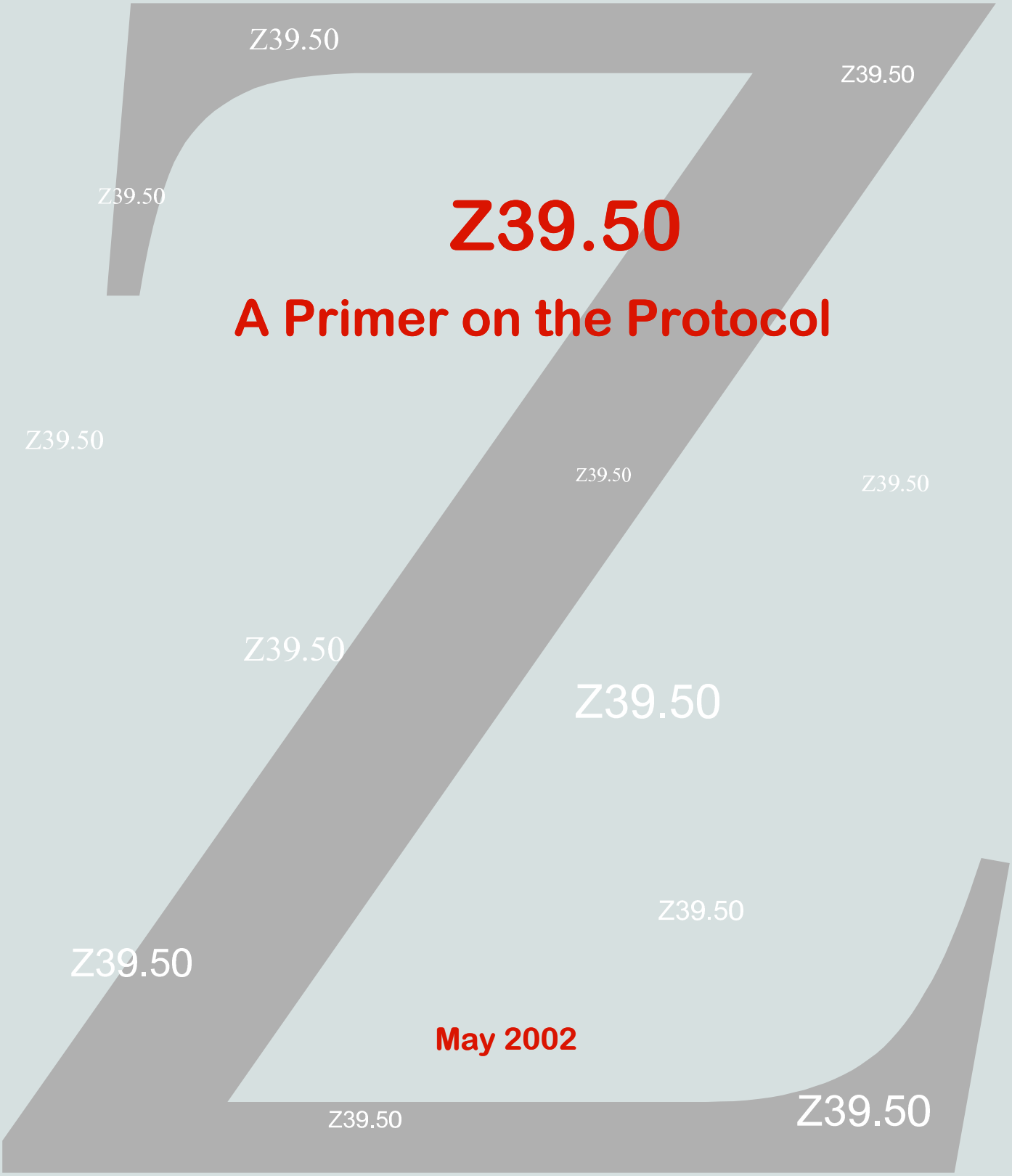
Z39.50

A Primer on the Protocol

May 2002



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This primer is an overview of the Z39.50 standard, which is defined simply as a standard that enables two computer systems on a network to communicate for the purpose of information retrieval. Specifically, this guide explains what Z39.50 is and how it works, identifies the benefits of using Z39.50 implementations, offers a brief history of the standard, describes some key technical features, provides examples of some Z39.50 applications, and forecasts the future direction of the standard.

The purpose of this primer is to give you enough information about the Z39.50 standard to understand its implications for information retrieval as it relates to your organization and work. Resources about organizations involved with Z39.50 and for learning more about the standard are also provided.

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What is Z39.50?

Z39.50 is an international standard protocol used by networked computer systems for information retrieval. It enables information seekers to search different systems on a network or the Internet through the use of a single user interface.

Z39.50 enables two computer systems on a network to communicate for the purpose of information retrieval.

Software and system vendors offer access to information from a diversity of unique systems with different hardware, software, interfaces, and database search commands. Compounding matters for the information seeker, the Internet provides access to a mind-boggling array of databases that grows daily. The challenge for users becomes how to find the right information painlessly amidst this vast array. The goal of Z39.50 is to reduce the complexity and difficulties of searching and retrieving information.

Z39.50 makes it easier to use the wealth of information resources on the Internet. When using Z39.50-enabled systems, a user in one system can search for electronic information in another system without having to know how that system works.

How does Z39.50 work?

Z39.50 operates in a client/server environment, acting as a common language that all Z39.50-enabled systems can understand. It is an Esperanto-like language that bridges the many "languages and dialects" that different information systems

What is a Standard?

A standard represents an agreement on how to do something or carry out some activity to arrive at predictable results. All standards published by the National Information Standards Organization (NISO) are developed by a consensus process that draws on the expertise of implementors and vendors, product developers, and users of those products; they are approved by the American National Standards Institute (ANSI).

Z39.50 is a NISO standard that defines specifications for protocols—rules and procedures—to promote communication between different systems. It was established by consensus and is publicly available to encourage widespread use. Z39.50 is one of many NISO standards that address the application of both traditional and new technologies to information management, retrieval, and storage.

The goal in developing and using technical standards in information services, libraries, and publishing is to make information systems easier to use and less expensive to operate. The adoption of these standards by those who develop and sell products and services offers the prospect of expanded domestic and international markets domestically and abroad. Consumers benefit from the adoption of standards as an assurance that products and services from varied sources meet a certain level of quality.

"speak." For Z39.50 communication and interoperation to take place, both the client and the server must be able to speak the Z39.50 language. Most Z39.50 implementations use the standard TCP/IP Internet communications protocol to connect the systems and Z39.50-compliant software to translate between them for search and retrieval. To the users this all happens behind the scenes; they simply see their familiar search and display interface.

To achieve this interoperability, Z39.50 standardizes the messages that clients and servers use for communication, regardless of what underlying software, systems, or platform are used. Z39.50 supports open systems, which means it is non-proprietary, or vendor independent. A client system that implements the Z39.50 protocol allows communication with diverse servers, and a server system that implements the protocol is searchable by clients developed by different vendors. Without having to know how the server works, the user performs a search through the Z39.50 interface on the client. Z39.50 governs how the client translates the search into a standard format for sending to the server. After receiving the search, the server uses Z39.50 rules to translate the search into a format recognized by the local database, performs the search, and returns the results to the user's client. The client's user interface software processes the results returned via Z39.50 with the goal of displaying them as closely as possible to the way records are displayed in the user's local system.

What is Client/Server Architecture?

Client/server architecture is a network architecture in which computing tasks are divided between two computing systems. The servers are shared systems that manage network services such as storage (file servers), printers (print servers), or databases (database servers). The client is a PC or workstation running a single user application that can operate independently or in communication with a server. Clients rely on servers for resources such as files, data, communications, network devices, and processes requiring greater computing power.

Solutions and Benefits of Z39.50

Originally Z39.50 was designed to help with searching very large bibliographic databases like those of OCLC and the Library of Congress. Today Z39.50 is used for a wide range of library functions that involve database searching, from cataloging to interlibrary loan to reference. With the rapid growth of the Internet, the Z39.50 standard has become widely accepted as a solution to the challenge of retrieving multimedia information including text, images, and digitized documents. Z39.50 is being used to access, for example, museum data, government information, and geospatial data. It can also be used to search the online databases and CD-ROMs that vendors develop according to a variety of design schemes. Without having to learn each system, users can search those databases with a single Z39.50 client, even though each uses a different hardware and software configuration, stores different types of data, and has different internal search logic.

Seamless access

This seamless access to multiple, diverse databases through a single interface is Z39.50's greatest benefit. Adding Z39.50 standard operability to an information system allows information systems to retain their uniqueness while providing a uniform interface to information seekers. Libraries can adopt a single standardized interface for their patrons to access the library's catalog, purchased CD-ROMs, subscriptions to online databases, and Internet resources. Data from a variety of sources can be extracted to a common format for offline use or import into a local database.

Resource sharing

Z39.50 can encourage resource sharing on a broad scale. In the library community, for example, Z39.50 supports:

- broadcast searching of library catalogs located on the Internet anywhere in the world,
- interlibrary loan through Z39.50's standardized approach for delivering holdings information, and
- online item ordering and document delivery.

A significant number of library catalogs are already available for Z39.50 searching through links from the Library of Congress website (see Organizations below), with more becoming available all the time. And as more organizations create networked access to digitized electronic collections, resource sharing is taking on new meaning beyond identification of physical documents and books for interlibrary loan.

Increased productivity

Because the search interfaces of different systems are transparent, users no longer need to master how to use each database, avoiding a potentially steep learning curve. Staff training time can be reduced for functions that require database searching, such as cataloging, acquisitions, and interlibrary loan. Easier access to electronic resources reduces all users' time spent in searching for relevant information.

A Short History of Z39.50

Z39.50 grew out of the Linked Systems Project (LSP), an initiative in the 1980s to standardize searching of the major bibliographic databases of OCLC, the Library of Congress, the Washington (Western) Library Network (WLN), and the Research Libraries Information Network of the Research Libraries Group (RLG). Working in parallel to the LSP initiative was the standardization effort around an information retrieval protocol for library applications under the auspices of NISO. The protocol developed from the LSP moved to NISO and was further developed into the Z39.50 information retrieval standard, approved as a NISO standard in 1988.

The Library of Congress was designated the official Maintenance Agency and Registration Authority for the Z39.50 standard. As such, LC provides information pertaining to the development and maintenance of the Z39.50 existing and future versions, as well as on the implementation and use of the Z39.50 protocol.

A group called the Z39.50 Implementors' Group (ZIG) assumed a primary role in ongoing development. In conjunction with the Z39.50 Maintenance Agency, the ZIG developed versions 2 and 3 of the Z39.50 protocol (1992 and 1995 respectively), and NISO used its normal consensus and voting procedures to approve the versions as National Standards.

Z39.50 is recognized worldwide as the international standard for networked information search and retrieval.

In just over a decade, Z39.50 has progressed through three versions, with each version adding vastly greater functionality and sophistication.

- Version 1 defined the core services of Z39.50.
- Version 2 formalized the structure of information to be exchanged based on the ISO standard data description language and encoding rules known as ASN.1 and BER. With consensus on Z39.50 version 2, vendors began to create applications rapidly and momentum grew for compliance with Z39.50 functionality.
- Version 3, the current version of the standard, builds on and includes version 2. Version 3 is extremely powerful in its support for simple to highly complex applications.

The current version of the Z39.50 standard is formally known as ANSI/NISO Z39.50-1995, *Information Retrieval—Application service definition and protocol specification.*

The International Organization for Standardization (ISO) approved two information retrieval standards in 1993 (ISO 10162 and ISO 10163-1). In 1998, ISO adopted the Z39.50 protocols and issued ISO 23950 *Information and documentation -- Information retrieval (Z39.50)*, withdrawing the two previous standards.

Z39.50 Globally

Z39.50 is recognized worldwide as the international standard for networked information search and retrieval. The convergence of Z39.50 and ISO 23950 has resulted in a global standard with extensive support for multiple languages and character sets.

The Z39.50 Maintenance Agency makes available a wide range of information about worldwide project implementation activities, including library automation systems and Z39.50 clients for access to reference databases, commercial applications, and important national and international government initiatives.

In North America and internationally, many library software vendors, bibliographic utilities, commercial sector, and government organizations have adopted Z39.50 functionality in their products. Some 67 organizations have registered as official Z39.50 implementors. Likewise, the number of independent developers of Z39.50 client and server software products and Z39.50 solutions for information and metadata management is growing.

The broad range of accessible information includes:

- Bibliographic data
- Government information
- Scientific and technical data
- Geospatial data
- Thesauri and other taxonomies
- Digital library collections
- Arts and humanities data
- Museum information

Certainly, libraries have been central to the spread of Z39.50 technologies to provide access to databases and catalogs. Increasingly, large-scale applications of Z39.50 functionality support access to information for users of entire library networks and consortia. For example, the Georgia statewide virtual library initiative, GALILEO, provides web access to hundreds of databases and information resources through a single interface to Z39.50-accessible databases. In a similar venture, the California State University created a statewide system called Pharos, based on the web and Z39.50, that allows CSU users anywhere to search for and retrieve a wide variety of information through a single interface.

Users may also access information via Z39.50 "Z-client" applications such as Bookwhere and Endnote. These standalone Z39.50 clients allow users to search and retrieve records from Z39.50 databases hosted on the Internet. Records can be retrieved in a variety of formats and imported into other applications. For example librarians can retrieve records in MARC format to load into a local catalog; a researcher can request records in a reference format for import into a bibliography manager.

Some Key Z39.50 Features

The basic function of Z39.50 is to negotiate a connection between the client and server on two systems, execute a search, and return the formatted results to the user's screen. In a Z39.50 session, the Z39.50 client software that initiates a request for the user is known as the Origin. The Z39.50 server software system that responds to the Origin's request is called the Target.

Facilities

Z39.50 groups together certain protocol devices that support certain tasks (e.g., negotiating a session, communicating a search, and requesting retrieval records) into **Facilities**.

The **Initialization Facility** allows the Origin (client) and Target (server) to negotiate and establish a Z39.50 search session, known as a Z-Association. This facility establishes the rules by which the client and server will operate. Establishing the rules involves sharing information about the version of the protocol being used by client and server, default character set, size and limits on records to be transferred, and other Z39.50 features, e.g., sorting, browsing, and deleting result sets.

The **Search Facility** allows the user to formulate a search query using an interface format familiar to the user. Z39.50 provides a rich vocabulary for expressing search queries. The user may identify specific fields to search (i.e., access points) and may create complex searches using Boolean operators, truncation, and other advanced searching techniques. Any given search term (e.g., word, phrase, or exact title) is characterized by attributes (see Attributes discussion below). Values from these attribute sets communicate to the server how it is to treat the term in the query (e.g., find the term "Twain" in author fields). Z39.50 also supports the maintaining of multiple search results and combining the results of those searches.

The **Present Facility** allows the user to request that some or all of the records identified as meeting the search criteria be transmitted from the server to the client. This facility also supports selection of data elements to include and format for transferring the records.

Other Z39.50 **Facility** protocols exist to support such features as:

- **Sort** the results as specified by the user.
- **Delete** search results, either entirely or for specified records.
- **Scan (**browse) through index lists of items such as subject terms, titles, author names, and other database fields.
- **Access Control** through authentication and passwords.
- **Resource Control** and termination of Z39.50 search sessions by the client or server.

Two newer facilities, not readily available yet in many implementations are:

- **Explain**, which allows the client to exchange information with the server about what type of server the client is querying and what the client must do to communicate successfully with that server in a Z39.50 session, and
- **Extended Services**, which define operations the client may request of the server, such as saving a search for later re-use or running a search query on a periodic schedule.

Attributes and attribute sets

When executing a Z39.50 search, the user specifies search terms that will be used to match against access points in the database. The user's query identifies information, or **attributes**, about those search terms that specify how that term is to be treated when used in the search.

There are several different types of attributes:

- **Use** attributes indicate database access points—searchable fields or indexes that can be specified in the search. For example, a search for an author's name or a publication title would be specified by use attributes.
- **Relation** attributes are descriptors that specify characteristics such as less than, greater than, or equal to. A search for books published during or later than 1996 would use relation attributes in the query.

Other attributes that control queries include truncation or omitting of characters in search terms and the structure of the query itself. In Z39.50 implementations, attributes belong to published attribute sets, which define characteristics of searches for given types of information. An example is the registered "bib-1" attribute set, which specifies a standard way that searches for bibliographic information will be executed.

Profiles

The rich functionality offered by the Z39.50 standard presents challenges for independently developed Z39.50 systems to interoperate. Simple claims by vendors that they "conform" to the standard do not yet ensure that their products will automatically interoperate with products from other vendors. The implementations take on very different faces depending on which Z39.50 facilities and services are included, as well as what local practices libraries follow in applying cataloging rules and authority control. The differences can result in interoperability failures between Z39.50 systems and have added to the complexity of Z39.50 implementation.

Solutions to these challenges take the form of Z39.50 profiles. A **profile** is a detailed specification of Z39.50 features and functions that an implementation will support, improving interoperability by:

- assisting customers in specifying requirements for Z39.50 products,
- defining a core set of Z39.50 features to assist vendors in configuring their products,
- increasing the market for Z39.50 products,
- improving users' success in information retrieval, and
- leveraging local investment in Z39.50 by providing global access to resources.

Profiles exist for applications involving government informa-

Questions to Ask Your Vendor

For institutions considering the adoption of Z39.50 products, these questions will help determine whether a vendor's product will support your organization's information access requirements.

- Which version of the Z39.50 standard has the vendor implemented? Specifically, which version 3 features and facilities has the vendor implemented?
- Does the vendor's implementation support key 1995 features—enhanced searching and retrieval, such as sorting of records, browsing database indexes, and extended services such as saved searches?
- What other facilities and extended services does the vendor's implementation support?
- Has the vendor's implementation demonstrated interoperability with other Z39.50 implementations? Are results available?
- Which Z39.50 profiles does the implementation conform to?
- What other developments does the vendor have underway or planned?
- How easy is installation and configuration of the vendor's product?
- Is the vendor actively working to support the continuing development of the Z39.50 standard?

tion (the Government Information Locator Service [GILS] Profile), geospatial data (the GEO Profile), and cultural heritage/ museum information (the CIMI Profile). Information about all profiles is available from the Z39.50 Maintenance Agency.

A profile initiative that has broad implications for libraries is the *Bath Profile: An International Z39.50 Specification for Library Applications and Resource Discovery*. This profile reflects international agreement on a core set of features including search and retrieval of bibliographic records and retrieval of holdings information. In the U.S., NISO is sponsoring the development of a national Profile that will address needs unique to U.S. bibliographic records. The NISO Profile will build upon the Bath Profile and a Z Texas Profile developed to support statewide resource sharing in Texas. It is expected to be released in 2002.

Z39.50, a rich environment

Through such features as facilities, attributes, and profiles, the Z39.50 standard provides a rich environment for information search and retrieval applications of all sorts of information. The protocol is extremely flexible and supports many optional features that allow it to extend far beyond its original goal of search and retrieval of bibliographic records in library catalogs. Z39.50 is designed to support modular implementation and allows for different sets of attributes, searches, and record formats to be defined as needed for the type of information to be searched, making implementation simple or quite complex depending on which features are selected.

Z39.50's Future

As the standard for global information retrieval, Z39.50 has matured and achieved a high degree of sophistication. User communities continue to find new applications to take advantage of the functionality. From its beginning, Z39.50 has been a lightning rod for key issues related to information access and in today's fast-moving Internet-based information environment, it continues to bring issues to light in the communities involved with developing, enhancing, and implementing information retrieval applications.

Thus the standard continues to evolve. A maintenance revision incorporating clarifications and amendments approved by the Z39.50 Implementors Group (ZIG) is being balloted in 2002. (These changes do not disrupt any existing applications of ANSI/NISO Z39.50-1995.) Additionally, ZIG has been discussing how to position Z39.50 in the web environment, incorporate newer technologies, and to make the protocol more widely accepted by non-library communities who could benefit from a standard information retrieval protocol.

In the fall of 2001, the ZIG approved the Z39.50 International Next Generation (ZING)

as an umbrella under which a variety of initiatives by Z39.50 implementors can be explored. Various approaches to bring Z39.50 into mainstream web technologies are being investigated as well as ways to ease the implementation burden and increase the benefits of Z39.50 to other communities. The ZIG anticipates that one or more of the ZING experiments may lead to a new version of the Z39.50 standard or be the beginning of a new standard.

Approaches to bring Z39.50 into mainstream web technologies are being investigated.

One ZING experiment, begun in the summer of 2001, is called the Search/Retrieve Web Service (SRW). This approach uses standard web technologies including Extensible Markup Language (XML), Hypertext Transfer Protocol (HTTP), Simple Object Application Protocol (SOAP), and Web Service Description Language (WSDL) to create a lightweight information retrieval protocol that fits in the context of web services. The SRW service derives from functionality currently available in the Z39.50 Search and Present Services yet simplifies how such functionality can be implemented by combining both Search and Present into this web service. SRW retains several key Z39.50 concepts such as abstract access points using Z39.50 attribute sets within a simple query structure called an experimental Common Query Language (CQL).

ZOOM, the Z39.50 Object Oriented Model, is a separate ZING initiative. ZOOM is developing specifications for application programming interfaces (API) to build any kind of Z39.50 client or client-based service. The initial draft of the ZOOM API addresses connections to remote databases and searching and retrieving records. The API can remove from application programmers their concern with the complex aspects of Z39.50 (e.g., ASN.1 and Basic Encoding Rules). Specific implementations of the abstract specification are being developed for various programming languages such as Perl, C++, Java, etc.

The networked environment needs a robust information retrieval protocol. Z39.50 provides it. Through ZING initiatives, the protocol may be entering a new evolutionary period, exploring how to evolve Z39.50 so that it remains a strategically important tool for libraries while showing its utility to other information communities that need to do information retrieval in a web or networked context.

XML

The Extensible Markup Language (XML) is the universal format for providing structure to documents and data on the Web. While HTML, also a markup language, addresses the presentation and look of information on the computer screen, XML defines the structure of the information and describes the role of the information components. XML uses the concept of a document composed of a series of entities. Each entity can contain one or more elements and each element can have certain attributes defining how it is to be processed by a computer system.

XML is based on SGML, the international Standard Generalized Markup Language defined in ISO 8879:1986, which was developed for technical documentation before the Web existed. XML kept the best, most functional features of SGML and dropped many of the optional, complex aspects to make a markup language suitable for the Web environment.

XML is called extensible because it supports internationalization and localization, allowing groups of people or organizations to create their own customized markup applications for exchanging information in their domain, however they choose to define that domain. The W3C, for example, has developed an XML format called the Resource Description Framework (RDF) that supports resource description and metadata applications such as music playlists, photo collections, and bibliographies.

More Information About Z39.50

The Standard

ANSI/NISO Z39.50-1995, *Information Retrieval — Application Service Definition and Protocol Specification* is available for free download from the NISO website <www.niso.org> or can be purchased in hard copy from NISO Press Fulfillment.

Z39.50 Organizations

The following organizations are actively involved with the development and maintenance of the Z39.50 standard and protocol.

National Information Standards Organization (NISO)

The National Information Standards Organization (NISO) develops and promotes technical standards used in a wide variety of information services. NISO is a nonprofit association accredited as a standards developer by the American National Standards Institute, the national clearinghouse for voluntary standards development in the United States. NISO's voting members and other supporters include a broad base of information producers and users including libraries, publishers, government agencies, and information based businesses. NISO is a leader in shaping international standards through the International Organization for Standardization (ISO) Technical Committee 46.

NISO's newsletter, *Information Standards Quarterly*, provides information about Z39.50 and other standards. To request a sample issue contact NISO at nisohq@niso.org.

NISO-L, NISO's list serv, will keep you informed about NISO's current national and international standards activities, availability of draft standards, committee progress, new standards and related publications, and news of interest to NISO's constituency. To subscribe send an e-mail message to: listproc@cni.org. The message should contain the line: subscribe NISO-L (your name). All postings to NISO-L are archived.

NISO maintains a Z39.50 Resource web page at <http://www.niso.org/standards/resources/Z3950_Resources.html>

Z39.50 Maintenance Agency

The Library of Congress is the official Maintenance Agency and Registration Authority for Z39.50 with responsibility for maintaining information about Z39.50 resources, the development and maintenance of Z39.50 (existing as well as future versions), the implementation and use of the Z39.50 protocol, and the register of implementors.

Their website, <http://lcweb.loc.gov/z3950/agency/>, provides links to software providers, Z39.50 hosts available for free interoperability testing, and numerous Z39.50 databases and collections accessible over the Internet.

Z39.50 Implementors Group (ZIG)

ZIG is a forum for implementors of Z39.50 that has overseen the development of Z39.50 since 1990. ZIG members represent libraries, universities, CD-ROM and library system vendors, publishers, consultants, information service vendors, and bibliographic utilities. Membership is open to anyone interested in development and implementation of Z39.50. Information on ZIG activities is posted at: <http://lcweb.loc.gov/z3950/agency/zig/>

Projects

Additional information about the projects mentioned in this primer can be found at the following project websites:

- Bath Profile <http://www.nlc-bnc.ca/bath/>
- Bookwhere <http://www.bookwhere.com/>
- California State University statewide library system, Pharos <http://pharos.lib.csus.edu/webpac/spharosstart.html>
- Consortium for the Computer Interchange of Museum Information (the CIMI Profile) <http://www.cimi.org/>
- Endnote <http://www.endnote.com/>
- Georgia statewide virtual library initiative, GALILEO <http://www.usg.edu/galileo/>
- Government Information Locator Service (GILS) <http://www.gils.net/>

- National Spatial Data Infrastructure (the GEO Profile) <http://fgdc.er.usgs.gov/fgdc.html>
- Z Texas Project <http://www.tsl.state.tx.us/ld/projects/z3950/>
- ZING Z39.50 International Next Generation (ZING) <http://lcweb.loc.gov/z3950/agency/zing>
- ZING Search/Retrieve Web Service (SRW) <http://lcweb.loc.gov/z3950/agency/zing/srw.html>
- ZING Common Query Language (CQL) <http://lcweb.loc.gov/z3950/agency/zing/cql.html>
- ZOOM Z39.50 Object Oriented Model <http://zoom.z3950.org>

Z39.50 Basics

The following articles provide additional introductory and explanatory information about Z39.50.

Online

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Z39.2-1994 (R2001)	Information Interchange Format
Z39.7-1995	Library Statistics
Z39.9-1992 (R2001)	International Standard Serial Numbering
Z39.14-1997	Guidelines for Abstracts
Z39.18-1995	Scientific and Technical Reports — Elements, Organization, and Design
Z39.19-1993 (R1998)	Guidelines for the Construction, Format, and Management of Monolingual Thesauri
Z39.20-1999	Criteria for Price Indexes for Printed Library Materials
Z39.22-1989	Proof Corrections
Z39.23-1997	Standard Technical Report Number Format and Creation
Z39.26-1997	Micropublishing Product Information
Z39.32-1996	Information on Microfiche Headers
Z39.41-1997	Printed Information on Spines
Z39.43-1993 (R2001)	Standard Address Number (SAN) for the Publishing Industry
Z39.47-1993 (R1998)	Extended Latin Alphabet Coded Character (ANSEL)
Z39.48-1992 (R1997)	Permanence of Paper for Publications and Documents in Libraries and Archives
Z39.50-1995	Information Retrieval (Z39.50): Application Service Definition and Protocol Specification (Version 3)
Z39.53-2001	Codes for the Representation of Languages for Information Interchange
Z39.56-1996	Serial Item and Contribution Identifier (SICI)
Z39.62-2000	Eye-Legible Information on Microfilm Leaders and Trailers and on Containers of Processed Microfilm on Open Reels
Z39.64-1989 (R1995)	East Asian Character Code for Bibliographic Use
Z39.66-1992 (R1998)	Durable Hardcover Binding for Books
Z39.71-1999	Holdings Statements for Bibliographic Items
Z39.73-1994 (R2001)	Single-Tier Steel Bracket Library Shelving
Z39.74-1996	Guides to Accompany Microform Sets
Z39.76-1996	Data Elements for Binding Library Materials
Z39.77-2001	Guidelines for Information About Preservation Products
Z39.78-2000	Library Binding
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