

The CIMI Profile
Z39.50 Application Profile for
Cultural Heritage Information

Release 1.0

March 1, 1998

Prepared by

Consortium for the Computer Interchange of Museum Information (CIMI)
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**This publication was made possible in part by a grant from the
U.S. National Endowment for the Humanities**

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Responsibility and Acknowledgments

The CIMI Profile is the result of a two-year effort by the Consortium for the Computer Interchange of Museum Information (CIMI) to investigate the use of ANSI/NISO Z39.50 for use in search and retrieval of cultural heritage information. The National Endowment for the Humanities funded Project CHIO (Cultural Heritage Information Online) in 1995 as a demonstration project for using Z39.50. John Perkins, CIMI executive director, was project director for CHIO. William E. Moen coordinated and managed the CIMI Z39.50 Working Group responsible for developing and testing the specifications included in this Profile. The CIMI Z39.50 Working Group consisted of a broad range of Z39.50 experts, experts in museum systems and museum information resources, software developers, and commercial vendors. See *Members of the CIMI Z39.50 Working Group* for a complete roster of all participants in the Working Group. The Working Group members' commitment to the vision and possibilities of distributed search and retrieval of cultural heritage information, and their willingness to contribute time and resources to make that vision concrete, made the development of the CIMI Profile possible.

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Foreword

The CIMI Profile is a set of technical specifications for the use of ANSI/NISO Z39.50–1995 (Version 3) in the search and retrieval of museum and other information resources related to cultural heritage information. Cultural heritage broadly defined includes art, architecture, cultural history, and natural history. Z39.50 is a standard computer-to-computer protocol for information retrieval that specifies communications between a client and server for purposes of search and retrieval of information. A profile is a technical document and uses the formal grammar and vocabulary of Z39.50. Because of the technical language of the Profile specifications, the functionality supported by those specifications may not always be clear. The purpose of this Foreword is to provide an overview of that functionality in terms that do not require familiarity with Z39.50.

The Profile can be understood as a set of technical specifications that govern the interaction of clients and servers for information retrieval from one or more distributed repositories. Three basic components of the Profile address searching a database, selecting information to be retrieved from the database, and structuring and packaging of the information to transfer from the server to the client:

- *Search:* Specifications that allow a client and a server to share an understanding of access points available for searching databases containing, for example, museum object records, images with associated text, and bibliographic records. This is accomplished by specifying a standard list of access points (represented by the CIMI–1 Attribute Set; see Appendix A) along with semantics for those access points (see Appendix C). The client and the server share an understanding of this standard list. The functionality provided by these specifications enables a client to express searches on specific concepts (e.g., the title of an object, the provenance of an object, the material or medium of the object) in a standard way that can be understood by a server.
- *Selection:* Specifications that allow a client and a server to share an understanding of database records for retrieving the entire record or specific units of information (e.g., one or more groups of database fields). This is accomplished by specifying a standard list of elements in the Abstract Record Structure for the Retrieval Record (see Section 6.4.3.3.) along with semantics for those elements. The client and the server share an understanding of this standard list. The functionality provided by these specifications enables a client to ask for groups of elements and enables the server to deliver those elements and label each element in a standard way for client processing.
- *Transfer:* Specifications that allow a client and a server to exchange a record in an understandable and processible format. Z39.50 calls these formats record syntaxes, and Section 6.4.3.5. discuss the required and optional syntaxes.

The following sections provide additional details about the functionality supported by the Profile for search and retrieval.

Search

A Z39.50 profile specifies the appropriate access points for a given application. The CIMI Profile's application area is cultural heritage information. Therefore, the standard list of access points includes those appropriate for searching museum object record databases, image databases, and bibliographic databases. Searches often consist of a search term and information about that term. For example, a user interested in searching for paintings by Van Gogh will want to express that search in such a way that the system knows to treat the search term "Van Gogh" as "person in the role of artist" and not as "subject of a painting." To allow a user to search multiple databases associated with one or more servers, it is necessary to standardize the expression of the search so that the client and server can communicate unambiguously. This is accomplished by defining an attribute set that identifies a list of access points and additional

information used to characterize search terms and express a query in a standard way. The CIMI Profile defines a CIMI–1 Attribute Set (see Appendix A).

The CIMI–1 Attribute Set also reflects emerging agreements within the broader museum community on a set of access points systems should support for searching. By examining existing community standards and existing production systems, and conducting an analysis of questions that users asked of museums, CIMI derived a standard list of access points (in the form of the Use Attributes in the Attribute Set).

The Attribute Set provides the mechanism for the client and server to share a common understanding, or *lingua franca*, for purposes of searching. When a user submits a search, for example, on provenance information, a server's database may or may not have provenance as a single access point, and it is up to the server implementor to map a search on provenance to the appropriate local database fields or indexes. A server that supports the CIMI Profile can understand when it receives a search for "provenance" because the search is represented and expressed in the standard form of the CIMI–1 Attribute Set.

CIMI prepared a document that illustrates the mapping between the CIMI–1 Use Attributes and corresponding elements and concepts from lists developed by other members of the museum community. For example, the CIMI–1 Use Attribute *owner* corresponds to the REACH element *Current Owner*, the AMICO element *Ownership*, and Spectrum element *Lender*. This mapping is intended to assist members of the community who "understand" specific labels for their data to see the relationship between their data and the attributes listed in the CIMI–1 Attribute Set.

To address the need for wide–interoperability and cross–domain searching, the CIMI–1 Attribute Set also integrated the concepts represented by the Dublin Core Metadata Element Set. By defining Use attributes associated with those elements, users can express a search in terms of access points represented or characterized by the Dublin Core elements.

Selection

For meaningful and useful retrieval of information from multiple databases, two requirements exist. First, the clients and servers must be able to interchange the database records (or elements from the database records) in formats they both can understand and process. Second, clients and servers need to share an understanding of the elements in those databases and be able to label those elements unambiguously.

A Z39.50 profile defines in a schema a list of elements likely to exist in actual databases. Each database reflects the needs of a local organization in terms of naming practices for database fields and their structure. The schema provides an abstract view of these databases. In this abstract view, database fields are enumerated as schema elements. Each element has a unique name, a unique numeric label, and a definition. A schema also shows the structural organization of those elements in an abstract record structure.

Similar to the CIMI–1 Attribute Set discussed above, the CIMI Schema and associated abstract record structure serve as the *lingua franca* for communication between the client and server for purposes of retrieval. The CIMI Schema abstractly identifies the units of information that may be found in a database of object records, images with associated text, and cataloging records. The schema does not dictate how a field is named in a database. Instead, it provides a standard way of referencing those elements or fields. For example, the CIMI Schema defines an element *dateOfOrigin*. A local database might have one or more fields related to the "date an object was created." Since semantics are provided for each of the CIMI schema elements (see Appendix C), an implementor knows that when a client requests the element *dateOfOrigin*, the unit(s) of information related to "date an object was created" should be returned.

The client can request groups of database fields to be returned. This is done through the Z39.50 convention of Element Set Name. The CIMI Profile defines several element set names (see Section 6.4.3.4.). Each element set name lists the elements that the server should return to the client. The CIMI Profile defines an element set name that includes the pertinent elements to enable a client to create a tombstone view of a database record. The client can also request that the server return the entire database record.

The server, using the standard list of elements defined in the Schema, labels all the units of information retrieved from the database record. Upon receipt of the record, the client can then manipulate and arrange the individual units of information appropriate to users of that client system (e.g., presenting captions in local language).

One important feature of the CIMI Profile is that it specifies how to return images (e.g., digitized photographs, audio clips, etc.). Specifications in the CIMI Profile allow a server to return one or more images associated with an object record. Since a local database may hold the image in more than one resolution (e.g., thumbnail and high-resolution), the CIMI Profile introduces the notion of rendition. A rendition represents a specific version of the image. Therefore, the server can return to the client one or more images as well as one or more renditions of each image. In addition, specific descriptive information can be retrieved for each image and for each resolution. The Profile supports this level of retrieval by defining the CIMI Schema and associated abstract record structure.

Transfer

The CIMI Schema and associated abstract record structure prescribe how the database elements/fields can be labeled unambiguously by the server. Transferring the elements from the server to the client requires one more set of specifications. Z39.50 use the concept of record syntax to address how the server packages up the database elements to return to the client. The record syntax prescribes how the server will format the database elements/fields to transfer to the client. The Z39.50 Generic Record Syntax (GRS-1, see Section 6.4.3.5.) allows the server to handle arbitrarily structured data, and GRS-1 is the record syntax required by the CIMI Profile. Since there is a need to support interoperability between libraries and museums, the CIMI Profile also provides guidance for using USMARC as a record syntax.

The CIMI Schema and the abstract record structure can be used outside of Z39.50. While it is out of scope for this Profile, it is possible to construct and return database records that follow the CIMI Schema in other formats such as Extensible Markup Language (XML).

Summary

While the CIMI Profile reflects a set of specifications for the use of Z39.50 for search and retrieval of cultural heritage information, it provides two important areas of standardization that can be useful outside of the the Z39.50 application environment.

First, the CIMI-1 Attribute Set defines a large set of access points that can be used to express searches. Because this list of access points was derived by empirical investigation and discussion with members of the community, it can be viewed as representing a common set of access points useful in the cultural heritage information environment.

Second, the CIMI schema and abstract record structure provide a standard list of database elements and an organization of those elements for interchanging cultural heritage information. The standard list can be used as a translation device or metalanguage for labeling local database elements and interchanging those elements with other systems.

Z39.50, as a computer-to-computer communications protocol, uses these structures to enable interoperable search and retrieval of information. In the context of the cultural heritage information application, the CIMI Profile specifies how to use the *lingua franca* of attributes and schema elements for robust information retrieval through Z39.50.

Maintenance and Evolution of the Profile

CIMI has overall responsibility for the maintenance of the Profile. CIMI serves as Editor of the Profile. The CIMI Z39.50 Working Group serves in an advisory capacity to the Editor. The CIMI Profile will evolve in response to community needs and requirements. The CIMI Profile, Release 1.0, provides a tested set of specifications. Implementors are encouraged to use the specifications defined in this Profile. They may, however, need to extend the specifications as necessary to support local requirements or to support functionality not yet addressed by the Profile. Implementors should be aware that private extensions may threaten interoperability with other implementations.

CIMI encourages experimentation with and extensions to the Profile, but implementors should use the existing specifications to their fullest extent and in the way they were intended (e.g., mapping pre-existing databases for Z39.50 access according to Profile specifications). For example, string tags (see Section 3.4.3.1.1.) may be used to label locally-defined fields in a retrieval record using GRS-1, but to encourage interoperability implementors should first exhaust the elements in the CIMI Schema before resorting to such measures. However, implementors can suggest to CIMI that commonly occurring database elements/fields need to be defined in the Schema so that string tags will not be necessary. Identifying and proposing such requirements can be accommodated by the procedures for maintaining the Profile.

Subsequent to the publication of the CIMI Profile Release 1.0, CIMI will develop a set of procedures for ongoing maintenance and management of the Profile. These will include:

- a process for submission of reports of defects, errors, and other problems with the Profile
- a process for submission of new requirements and proposed work items
- a process for consensus building on changes to the Profile
- a process for publication and submission of the Profile to appropriate bodies for endorsement (e.g., the ZIG) and approval as an International Registered Profile (ISO Technical Committee 46, Subcommittee 4).

These procedures provide a formal mechanism that CIMI and others can use for systematic and consistent management of the evolution of the CIMI Profile.

1. Introduction

This document describes an application profile for the use of *ANSI/NISO Z39.50–1995, Information Retrieval (Z39.50): Application Service Definition and Protocol Specification* [10] for search and retrieval of cultural heritage information. This profile is named the CIMI Profile, where CIMI refers to the Consortium for the Computer Interchange of Museum Information. Cultural heritage information includes resources covering art, architecture, cultural history, and natural history. The CIMI Profile includes specifications for using Z39.50 in this application, although specifications in the Profile, such as the CIMI–1 Attribute Set for searching museum information, may have utility outside of Z39.50 implementations.

2. Background

CIMI initiated a demonstration project in 1995 funded in part by the U.S. National Endowment for the Humanities to enable users to search for and retrieve cultural heritage information from disparate and distributed information systems, including museums, libraries, image banks, etc. Project CHIO (Cultural Heritage Information Online) consisted of two interrelated demonstration projects, CHIO Structure and CHIO Access, to show respectively the utility of the Standard Generalized Markup Language (SGML) and Z39.50. The development of the CIMI Profile and the experience during Project CHIO are documented in the final report to the National Endowment for the Humanities. A public version of that report is available at the CIMI website <www.cimi.org>.

During 1995–1997, CHIO Access explored the utility of Z39.50 to search and retrieve museum information captured in digital form (e.g., object records, images). It demonstrated how Z39.50 offers solutions to the difficulties in achieving meaningful online search and retrieval of museum information of different types and structure (e.g., structured records, full-text documents, images) regardless of the hardware and software used to store the data or search for it.

To implement Z39.50 in this application, the CIMI Z39.50 Working Group developed the CIMI Profile. The Working Group consisted of Z39.50 experts, experts in museum systems and museum information resources, software developers, and commercial vendors. The specifications included in the CIMI Profile reflect the consensus of this group, input from a range of stakeholders, and practical implementation experience through the 1997 CIMI Z39.50 Interoperability Testbed.

The initial development of the CIMI Profile occurred as a component of the Project CHIO demonstration. The CIMI Z39.50 Working Group agreed that a pragmatic approach should be used in developing the Z39.50 specifications. This agreement had important consequences:

- The Profile and associated implementations were built incrementally, and actual implementation experience guided subsequent extensions to the Profile and extensions to the implementations; and
- The existing implementations that provided museum information for Project CHIO and the interoperability testbed were the basis on which a number of Profile decisions rested (e.g., attribute sets, element sets, record syntax, etc.).

CIMI issued a draft version of the CIMI Profile in June 1996. In 1997, CIMI organized an interoperability testbed with the goal of gaining practical implementation experience with specifications from the draft CIMI Profile. A subset of the draft CIMI Profile constituted an evolving set of specifications recorded in several versions of an implementors agreement that guided implementations in the testbed. Upon completion of the testbed and with input from participants in the Aquarelle Project and other feedback, the CIMI Profile underwent major revision. This document is the culmination of these efforts.

3. Scope and Field of Application

The CIMI Profile specifies a subset of Z39.50 features, options, and parameters needed to support functional and user requirements for search and retrieval of cultural heritage information. Z39.50 clients supporting this Profile (i.e., CIMI Z-clients) will be able to interconnect with any Z39.50 server supporting this Profile (i.e., CIMI Z-servers). These CIMI Z-clients will behave in a manner that allows interoperability with a CIMI Z-server. Clients that support Z39.50 but do not implement the CIMI Profile (e.g., existing bibliographic Z39.50 clients) will be able to access CIMI Z-servers but with less than full CIMI functionality. Section 6.6. defines several conformance levels to enable predictable interoperability between CIMI Z-clients and Z-servers, and other Z39.50 clients and servers.

The CIMI Profile, Release 1.0, provides specifications for search and retrieval of several types of cultural heritage information resources. These resources may be held in one or more databases accessible via one or more CIMI Z-servers or other Z39.50 implementations. A user may search these databases to retrieve digital representations of museum information such as object records, images with associated text, and cataloging records. These representations may be compound documents comprising multimedia formats of resources.

The CIMI Profile is a companion profile to the *Z39.50 Profile for Access to Digital Collections* [7], which means that the CIMI Profile specifies compatible extensions to that Profile (hereafter referred to as the Digital Collections Profile). The CIMI Profile, Release 1.0, utilizes a small subset of that profile, but future releases of the CIMI Profile may utilize additional specifications from the Digital Collections Profile.

The CIMI Profile addresses Z39.50 search and retrieval of cultural heritage information (e.g., intersystem interactions and information interchange) but imposes no restrictions on user interface requirements, the internal structure of databases that contain the digital information objects, or search engine functionality.

4. References

The following list contains documents with provisions which, through reference in this text, constitute provisions of the CIMI Profile. At the time of this publication, the editions indicated were valid. All documents are subject to revision, and parties to agreements based on the CIMI Profile are warned against automatically applying any more recent editions of the documents listed below. The nature of references made by the Profile to these documents is that they may be specific to a particular edition. In addition, this list contains other documents that can be consulted for further information pertinent to this Profile.

- [1] Art Information Task Force. (1995). *Categories for the Description of Works of Art*. Santa Monica, CA: Art History Information Program Publications. <<http://www.gii.getty.edu/cdwa/FULLBIB.HTM>>.
- [2] *Attribute Set Bib-1 (Z39.50-1995): Semantics*. (1995, September). <<ftp://ftp.loc.gov/pub/z3950/defs/bib1.txt>>.
- [3] Conference of European National Librarians. (1997, October 15). *Z39.50 Bib-1 Attribute Set Profile for CENL, Version 1.1*. <http://linnea.helsinki.fi/z3950/cenl_profile.html>.
- [4] Dublin Core Metadata Element Set. <http://purl.org/metadata/dublin_core>.
- [5] Janney, Kody and Sledge, Jane. (1995, September). *A User Model for CIMI Z39.50 Application Profile*. <http://www.cimi.org/documents/Z3950_app_profile_0995.html>.
- [6] Library of Congress. (n.d.). *ATS-1 Profile*. <<http://lcweb.loc.gov/z3950/agency/profiles/ats.html>>.

- [7] Library of Congress. (1996). *Z39.50 Profile for Access to Digital Collections*. <<http://lcweb.loc.gov/z3950/agency>>.
- [8] Lynch, Clifford A. (1994). *RFC 1729, Using the Z39.50 Information Retrieval Protocol in the Internet Environment*. <<http://ds.internic.net/rfc/rfc1729.txt>>.
- [9] National Information Standards Organization. (1994). *ANSI/NISO Z39.2–1994. Information Interchange Format*. Bethesda, MD: NISO Press.
- [10] National Information Standards Organization. (1995). *ANSI/NISO Z3950–1995. Information Retrieval (Z39.50): Application Service Definition and Protocol Specification*. Bethesda, MD: NISO Press. Electronic version of Z39.50 available at the Z39.50 Maintenance Agency. <<http://lcweb.loc.gov/z3950/agency>>.
- [11] Network Development and MARC Standards Office. (1997). *Dublin Core/MARC/GILS Crosswalk*. <<http://lcweb.loc.gov/marc/dccross.html>>.
- [12] System Simulation Ltd. (1997, September 26). *Aquarelle Z39.50 Profile, Revision 1.15*.
- [13] *USMARC Format for Bibliographic Data*. Washington, DC: Library of Congress, Cataloging Distribution Service. See also <<http://lcweb.loc.gov/marc/>>.
- [14] Z39.50 Implementors Agreement. (1996). *Returning Diagnostics in an Init Response*. Z39.50 Implementors Agreements are available from the Z39.50 Maintenance Agency. <<http://lcweb.loc.gov/z3950/agency/agree/initdiag.html>>.
- [15] Z39.50 Maintenance Agency. <<http://lcweb.loc.gov/z3950/agency>>.
- [16] Z39.50 Maintenance Agency. *Z39.50 Date/Time Definition*. <<http://lcweb.loc.gov/z3950/agency/defs/date.html>>.
- [17] Z39.50 Maintenance Agency. *TagSet –G and –M Elements*. <<http://lcweb.loc.gov/z3950/agency/defs/tag-gm.html>>.

5. Definitions

For purposes of this Profile, the following definitions apply. For definitions of Z39.50 terms and concepts not listed here, see *ANSI/NISO Z39.50–1995, Information Retrieval (Z39.50): Application Service Definition and Protocol Specification* [10]. For definitions of terms and concepts related to the Digital Collections Profile, see *Z39.50 Profile for Access to Digital Collections* [7].

Cataloging record. Refers to records of bibliographic information describing or representing books or other bibliographic entities.

Companion Profile. In terms of the Digital Collections Profile, a set of compatible extensions to the Digital Collections Profile to accommodate the specific requirements of an application.

Object Record. A record that provides descriptive information about a museum object or site (e.g., its component parts, measurements, weight, creation and creator, ownership, history of use, materials and techniques used in its manufacture, inscriptions, identifying numbers, historical context, rights and restrictions, credit line for display or publication). An object record enables a museum to be accountable for and to uniquely identify an object.

Profile. Specifications for the use of a particular standard (or group of standards) to support a particular application, function, community, environment, or class of information. A profile selects options, subsets, values of parameters, etc., where these choices are left open in a standard, and where these selections are necessary to accomplish identified functions. A profile may also specify aspects of client and server behavior that are beyond the scope of the base standards. Purposes of a profile include: (1) to provide a specification for vendors to build to, resulting in products that will interoperate; and (2) to provide a specification that customers may reference for procurement purposes.

Rendition. An element in the CIMI Schema that occurs for each version (e.g., differing resolutions, color-depth, and sampling rate) of an image (where image can be any type of digital resource including audio, video, and images).

Tombstone. A brief record that comprises sufficient elements from a database record to enable the presentation essential information about an object.

6. Z39.50 Specifications

This section details the required services available from Z39.50. These required services address the use of attribute sets for searching museum and bibliographic information, and the processes by which a client requests both content and syntax of retrieval records from a server.

6.1. Protocol Version

The CIMI Profile requires clients and servers to support Z39.50 Version 3 as specified in Z39.50–1995.

6.2. Z39.50 Objects Supported

The CIMI Profile addresses the following Z39.50 objects by reference to registered Object Identifiers (OIDs). For information on Z39.50 OIDs, see Z39.50 Maintenance Agency [15]. Requirements regarding CIMI Z–client and Z–server support of these objects differ according to the Conformance Levels described in Section 6.6. Conformance.

Object	OID
Bib–1 attribute set	1.2.840.10003.3.1
CIMI–1 attribute set	1.2.840.10003.3.8
Bib–1 diagnostic set	1.2.840.10003.4.1
GRS–1 record syntax	1.2.840.10003.5.105
SUTRS record syntax	1.2.840.10003.5.101
USMARC record syntax	1.2.840.10003.5.10
Digital Collections Schema	1.2.840.10003.13.3
CIMI Schema	1.2.840.10003.13.5
TagSet–M	1.2.840.10003.14.1
TagSet–G	1.2.840.10003.14.2
TagSet–Collections	1.2.840.10003.14.5
TagSet–CIMI	1.2.840.10003.14.6

6.3. Communication Services

When the Transmission Control Protocol (TCP) is used as the transport service, the specification for Z39.50 implementations’ use of TCP is found in *RFC 1729, Using the Z39.50 Information Retrieval Protocol in the Internet Environment* [8].

6.4. Z39.50 Services

The CIMI Profile requires clients and servers to support four Z39.50 (Version 3) services:

- Init
- Search
- Present
- Close

No additional services are required for conformance to the CIMI Profile. CIMI Z-clients and Z-servers optionally may use other Z39.50 services.

Standard Z39.50 Init Service negotiation procedures control the use of all services.

6.4.1. Init

CIMI Z-clients may use the IDAuthentication parameters to transmit authentication information (e.g., userid and password). CIMI Z-servers may or may not require authentication. The Profile specifies no other security requirements.

6.4.2. Search

The CIMI Profile requires clients and servers to support Z39.50 Type 1 queries which are general purpose Boolean query structures.

6.4.2.1. Attribute Sets

The CIMI Profile requires clients and servers to support the CIMI-1 Attribute Set defined by this Profile (see Appendix A for the CIMI-1 Attribute Set).

CIMI-1 imports all attribute types and selected attribute values from the Bib-1 Attribute Set. CIMI-1 defines one new attribute type, Authority. Use attribute values defined for the CIMI-1 Attribute Set are derived in part from the CIMI Access Points [5], the Dublin Core Metadata Element Set [4], and other relevant cultural heritage information guidelines and standards. Appendix C provides semantics for CIMI-1 Use attribute values.

CIMI Z-clients and Z-servers must support Bib-1 to a limited extent. Both must recognize the Bib-1 Attribute Set OID (1.2.840.10003.3.8.) to the extent that a CIMI Z-client may pass the OID in a query and CIMI Z-servers may receive and process a query with the OID. Conformant servers will support all attribute types and selected Use attribute values according to Section 6.6. Conformance. Support for attributes in this context means that the CIMI Z-server will recognize the Use attributes, and a search using the Use attributes listed for a Conformance Level will always result in a valid result set (which could contain 0 hits). This implies that all CIMI conformant implementations must have search capabilities for the listed Use attributes for each specific conformance level claimed. A CIMI Z-server may, if appropriate to its database, support additional attributes from Bib-1. Semantics for Bib-1 attributes can be found in *Attribute Set Bib-1 (Z39.50-1995): Semantics (September 1995)* <<ftp://ftp.loc.gov/pub/z3950/defs/bib1.txt>> [2].

The selection of Bib-1 Use attributes in CIMI-1 is based on emerging consensus within the Conference of European National Libraries (CENL) as documented in the *Z39.50 Bib-1 Attribute Set Profile for CENL* <http://linnea.helsinki.fi/z3950/cenl_profile.html> [3], which in turn is closely related to the U.S. *ATS-1 Profile* <<http://lcweb.loc.gov/z3950/agency/profiles/ats.html>> [6]. Both profiles address semantic interoperability between bibliographic Z39.50 clients and servers. Adopting these Bib-1 Use attributes in CIMI-1 increases the likelihood of semantic interoperability between those Z39.50 clients and servers and CIMI Z-clients and Z-servers.

A CIMI Z-server is required to return an appropriate diagnostic when it receives a query containing attribute values and types not supported. Appropriate diagnostics are listed in Bib-1 Diagnostic Set and include, for example:

- 113 — Unsupported attribute type
- 114 — Unsupported use attribute
- 123 — Unsupported attribute combination
- 1024 — Unsupported attribute.

See Section 6.5. Diagnostic Messages for use of the unsupported attribute diagnostic.

Appendix B provides additional information and guidance on the CIMI-1 Attribute Types and their values, including default values for attribute types.

6.4.3. Retrieval

This section describes the components and procedures for using Z39.50 to return records in response to a query. The CIMI Profile specifies a CIMI tagSet that identifies elements, a CIMI Schema, and an associated abstract record structure. The Profile also defines an Abstract Record Structure (ARS) for the retrieval record. The ARS specifies the use of elements from tagSet-M, tagSet-G, tagSet-Collections, and tagSet-CIMI.

The CIMI Profile is a companion profile to the *Z39.50 Profile for Access to Digital Collections* [7] (referred to as the Digital Collections Profile). The CIMI Profile uses the Digital Collections Schema's "descriptive object record" in a conformant manner. The CIMI Profile, Release 1.0, focuses on retrieval of resources rather than navigation among collections, and the ARS for the retrieval record specifies only those elements of the Digital Collections Schema that are pertinent to the goal of retrieval. CIMI Z-clients and Z-servers optionally may use, in a conformant manner, other Digital Collections Profile specifications. CIMI anticipates future releases of the CIMI Profile will include additional specifications from the Digital Collections Profile.

6.4.3.1. The Retrieval Record: An Overview

The CIMI Profile defines a retrieval record to support three levels of semantic interoperability by partitioning the record into three levels of elements. In order of occurrence in the record, the record contains: elements that a Z39.50 client may understand even if it does not recognize any specific schema (i.e., "generic level of semantic interoperability"); elements that a Z39.50 client may understand if it recognizes the Digital Collections Schema but not the CIMI Schema (i.e., "Digital Collections level of semantic interoperability"); elements understandable to a Z39.50 client that recognizes the CIMI Schema (i.e., "CIMI level of semantic interoperability"). This partitioning allows for wider semantic interoperability between CIMI Z-servers and non-CIMI Z39.50 clients while enabling meaningful semantic interoperability for CIMI Z-clients.

Thus the ARS for the retrieval record specifies:

1. At the beginning of a retrieval record there may occur generic elements (in the form of tagSet–M and tagSet–G elements).
2. Following that, the Digital Collections Schema is assumed, and a Digital Collections–aware client can recognize and process these elements.
3. Following those elements, the CIMI Schema is assumed, and a CIMI Z–client can recognize and process the remaining elements in the record.

At the generic level of semantic interoperability, a generic Z39.50 client might search databases that include collection and object descriptive records as well as other types of records. By including generic elements at the top level of a retrieval record, such a client will be able to partially, if not fully, process these retrieval records.

At the Digital Collections level of semantic interoperability, a Z39.50 client aware of the Digital Collections Schema may perform a distributed search across multiple domains and over multiple collections including those provided by a CIMI Z–server. It may retrieve a record from the CIMI Z–server, and discover that there is a potential object of interest, even though the Z39.50 client is not able to fully process the record.

At the CIMI level of semantic interoperability, a Z39.50 client aware of the CIMI–specific Schema should be able to fully process a CIMI retrieval record.

To accommodate these levels of semantic interoperability, it is necessary to insert the element *schemaldentifier* (tagSet–M element 1) at both interoperability boundary points within a retrieval record. The Digital Collections Schema identifier occurs when the record changes from the generic to the Digital Collections level, and the CIMI Schema identifier occurs when the record changes from Digital Collections level to the full CIMI level of semantic interoperability.

The term "abstract record structure" is commonly used within the context of a specific schema. For the CIMI Profile, the Abstract Record Structure for the Retrieval Record transcends the CIMI schema. Therefore, the CIMI Profile distinguishes:

- the CIMI Schema–specific abstract record structure (see Section 6.4.3.2.2.)
- the abstract record structure defining the complete retrieval record (see Section 6.4.3.3.).

6.4.3.1.1. Tag Types

At the generic level of semantic interoperability, the Abstract Record Structure for the Retrieval Record assumes the use of Tag Types 1, 2, and 3. At the Digital Collections level of semantic interoperability, the Abstract Record Structure for the Retrieval Record assumes the use of Tag Types 1, 2, 3, and 4. At the CIMI level of semantic interoperability, the Abstract Record Structure for the Retrieval Record assumes the use of Tag Types 1, 2, 3, 4, and 5.

Tag Type	Definition
1	Elements from tagSet–M defined in Z39.50–1995 (Appendix TAG, TAG.2.1.). A server may include elements from tagSet–M at its discretion, and a client may ignore any tagSet–M elements except <i>schemalIdentifier</i> .
2	Elements from tagSet–G defined in Z39.50–1950 (Appendix TAG, TAG.2.2.). A server may include elements from tagSet–G not listed in the Abstract Record Structure for the Retrieval Record, and a client may ignore them.
3	Reserved for tags locally defined by a target. Servers that send string tags for locally–defined elements will use tagType 3 to identify those elements. String tags should be used only if available elements defined in tagSet–M, tagSet–G, tagSet–Collections, and tagSet–CIMI are not adequate.
4	Elements from tagSet–Collections defined in <i>Z39.50 Profile for Access to Digital Collections</i> < http://lcweb.loc.gov/z3950/agency/profiles/collections.html >
5	Elements from tagSet–CIMI as defined in the CIMI Profile (see Section 6.4.3.1.2.)

6.4.3.1.2. The CIMI TagSet

This section defines the CIMI tagSet by identifying the tag value, element name, and ASN.1 datatype for each element. TagSet–CIMI is a registered object: OID = 1.2.840.10003.14.6.

Tag	Element	ASN.1 Datatype
1	repositoryName	InternationalString
2	subject	InternationalString
3	objectID	InternationalString
4	nationalityCultureRace	InternationalString
5	materialMedium	InternationalString
6	reserved	
7	creditLine	InternationalString
8	dateOfBirth	InternationalString
9	dateOfDeath	InternationalString
10	role	InternationalString
11	placeOfOrigin	InternationalString
12	processTechnique	InternationalString
13	dimensions	InternationalString
14	stylePeriod	InternationalString
15	provenance	InternationalString
16	relatedObjects	InternationalString
17	quantity	InternationalString
18	award	InternationalString
19	reserved	
20	collection	InternationalString
21	reserved	
22	inscriptionMark	InternationalString
23	reserved	
24	association	MoreInfo (see Section 6.4.3.2.1.)
25	content	MoreInfo (see Section 6.4.3.2.1.)
26	repositoryPlace	InternationalString
27	reserved	
28	mrObject	MrObject (see Section 6.4.3.2.1.)
29	rendition	Rendition (see Section 6.4.3.2.1.)

Tag	Element	ASN.1 Datatype
30	resource	OCTET String, External, or InternationalString
31	objectName	InternationalString
32	objectTitle	InternationalString
33	bibliographicTitle	InternationalString
34	reserved	
35	relatedTextualReferences	InternationalString
36	creatorInfo	CreatorInfo (see Section 6.4.3.2.1.)
37	reserved	
38	owner	InternationalString
39	contentGeneral	InternationalString
40	reserved	InternationalString
41	place	InternationalString
42	event	InternationalString
43	activity	InternationalString
44	reserved	
45	dateOfOrigin	InternationalString
46	contextHistorical	InternationalString
47	contextArchaeological	InternationalString
48	copyrightRestriction	InternationalString
49	creatorGeneral	InternationalString
50	associationGeneral	InternationalString
51	objectLanguage	InternationalString
52	condition	InternationalString
53	physicalDescription	InternationalString
54	wallTextLabel	InternationalString
55	protectionStatus	InternationalString
56	protectionDate	InternationalString
57	spatialReferencingSystem	InternationalString
58	x-coordinateInSpatialReferencingSystem	InternationalString
59	y-coordinateInSpatialReferencingSystem	InternationalString
60	fieldCollector	InternationalString
61	dateCollected	InternationalString
62	agePeriod	InternationalString
63	typeSpecimen	InternationalString
64	address	InternationalString
65	periodName	InternationalString
1000– 1999	reserved [for use in Aquarelle Project]	

6.4.3.2. The CIMI Schema

The CIMI Schema uses elements defined in tagSet–CIMI as well as tags from other registered tag sets. The CIMI Schema defines the constructed datatypes identified in the CIMI tagSet and describes an abstract record structure that provides the layout and ordering of elements. The CIMI Schema is a registered object: OID = 1.2.840.10003.13.5.

The Schema addresses the need to retrieve one or more "images" (where "images" can be any type of digital resource including audio, video, images) that may be available in one or more versions (e.g., differing resolutions, color–depth, and sampling rate). The element *mrObject* is a repeating element that occurs for each instance of an image, and each available version occurs in the repeating element *rendition*. Descriptive metadata may be provided for each instance of *mrObject* and for each instance of

rendition (thus **metadata** and multiple **renditions**). Since information provided in the subelements for *mrObject* may apply to subelements in the element *rendition* (e.g., the value of the *title* subelement in *mrObject* is the same for that subelement in *rendition*), the subelements of *rendition* can assume by inheritance the values of the subelements from *mrObject*. Only in cases where a subelement in *rendition* takes on a value different from its parallel subelement in *mrObject* is there a need to include that subelement in the *rendition* element.

Within *rendition*, the subelement *resource* carries either a URL for the image or the actual bits that comprise the image. The subelement *resource* has information provided by appliedVariant (see Section 6.4.3.5.1 Use of GRS-1).

6.4.3.2.1. Constructed Datatypes

The CIMI Schema defines four constructed datatypes: *CreatorInfo*, *MrObject*, *Rendition*, *MoreInfo*. ASN.1 datatypes for tags from other tagSets (e.g., tagSet-G and tagSet-M) can be found in the definitions of those tagSets. See Z39.50 Maintenance Agency [17] <<http://lcweb.loc.gov/z3950/agency/defs/tag-gm.html>> for definitions of tagSet-G and tagSet-M.

Datatype *CreatorInfo* is structured as follows:

Element	Occurrence	Repeatable	Tag
name	mandatory	no	(2,7)
nationalityCultureRace	optional	yes	(5,4)
dateOfBirth	optional	yes	(5,8)
dateOfDeath	optional	yes	(5,9)
role	optional	yes	(5,10)

Datatype *MrObject* is structured as follows:

Element	Occurrence	Repeatable	Tag
title	optional	No	(2,1)
creator	optional	No	(2,2)
contributor	optional	yes	(2,32)
date*	optional	no	(2,8)
description	optional	no	(2,17)
type	optional	no	(2,22)
language	optional	no	(2,20)
subject	optional	yes	(2,21)
publisher	optional	no	(2,31)
format	optional	no	(2,27)
source	optional	no	(2,33)
relation	optional	no	(2,30)
coverage	optional	no	(2,34)
rights	optional	no	(2,29)
rendition	optional	yes	(5,29)

*The element date may be returned as either GeneralizedTime or EXTERNAL datatypes. See Z3950Date/Time [16] <<http://lcweb.loc.gov/z3950/agency/defs/date.html>> for specifications when using EXTERNAL.

Datatype *Rendition* is structured as follows:

Element	Occurrence	Repeatable	Tag
resource	mandatory	No	(5,30)
title	optional	No	(2,1)
creator	optional	No	(2,2)
contributor	optional	Yes	(2,32)
date*	optional	No	(2,8)
description	optional	No	(2,17)
type	optional	No	(2,22)
identifier	optional	No	(2,28)
language	optional	No	(2,20)
subject	optional	Yes	(2,21)
publisher	optional	No	(2,31)
format	optional	No	(2,27)
source	optional	No	(2,33)
relation	optional	No	(2,30)
coverage	optional	No	(2,34)
rights	optional	No	(2,29)

*The element date may be returned as either GeneralizedTime or EXTERNAL datatypes. See *Z3950DateTime* [16] <<http://lcweb.loc.gov/z3950/agency/defs/date.html>> for specifications when using EXTERNAL.

Datatype *MoreInfo* is structured as follows:

Element	Occurrence	Repeatable	Tag
name	optional	No	(2,7)
place	optional	No	(5,41)
event	optional	No	(5,42)
activity	optional	No	(5,43)
description	optional	no	(2,17)

6.4.3.2.2. The CIMI Schema–Specific Abstract Record Structure

Associated with the CIMI Schema is a specific abstract record structure that identifies the ordering, tag values, and tag paths of the elements that are relevant only to the CIMI Schema. This Abstract Record Structure comprises the CIMI Schema–specific portion of the Abstract Record Structure for the Retrieval Record (see Section 6.4.3.3.).

TagPath	Element	Occurrence	Repeatability
(5,31)	objectName	optional	yes
(5,32)	objectTitle	optional*	no
(5,33)	bibliographicTitle	optional*	no
(5,49)	creatorGeneral	optional	no
(5,36)	creatorInfo	mandatory	yes
(5,36)(2,7)	name	mandatory	no
(5,36)(5,8)	dateOfBirth	optional	no
(5,36)(5,9)	dateOfDeath	optional	no
(5,36)(5,4)	nationalityCultureRace	optional	no
(5,36)(5,10)	role	optional	no
(5,60)	fieldCollector	optional	yes
(5,1)	repositoryName	optional	no
(5,26)	repositoryPlace	optional	no
(5,38)	owner	optional	yes

TagPath	Element	Occurrence	Repeatability
(5,7)	creditLine	optional	no
(5,2)	subject	optional	yes
(2,31)	publisher	optional	no
(5,3)	objectID	mandatory	no
(5,5)	materialMedium	optional	yes
(5,12)	processTechnique	optional	yes
(5,13)	dimensions	optional	yes
(5,11)	placeOfOrigin	optional	no
(5,45)	dateOfOrigin	optional	no
(5,61)	dateCollected	optional	no
(5,62)	agePeriod	optional	yes
(5,63)	typeSpecimen	optional	no
(5,14)	stylePeriod	optional	yes
(5,65)	periodName	optional	yes
(5,15)	provenance	optional	yes
(5,17)	quantity	optional	yes
(5,18)	award	optional	yes
(5,20)	collection	optional	yes
(5,22)	inscriptionMark	optional	yes
(5,51)	objectLanguage	optional	yes
(5,52)	condition	optional	yes
(5,53)	physicalDescription	optional	yes
(5,55)	protectionStatus	optional	yes
(5,56)	protectionDate	optional	yes
(5,57)	spatialReferencingSystem	optional	yes
(5,58)	x-coordinateInSpatialReferencingSystem	optional	yes
(5,59)	y-coordinateInSpatialReferencingSystem	optional	yes
(5,64)	address	optional	yes
(5,16)	relatedObjects	optional	yes
(5,35)	relatedTextualReferences	optional	yes
(5,50)	associationGeneral	optional	yes
(5,24)	association	optional	yes
(5,24)(2,7)	name	optional	yes
(5,24)(5,41)	place	optional	yes
(5,24)(5,42)	event	optional	yes
(5,24)(5,43)	activity	optional	yes
(5,24)(2,17)	description	optional	yes
(5,39)	contentGeneral	optional	yes
(5,25)	content	optional	yes
(5,25)(2,7)	name	optional	yes
(5,25)(5,41)	place	optional	yes
(5,25)(5,42)	event	optional	yes
(5,25)(5,43)	activity	optional	yes
(5,25)(2,17)	description	optional	yes
(5,46)	contextHistorical	optional	yes
(5,47)	contextArchaeological	optional	yes
(5,48)	copyrightRestriction	optional	yes
(5,54)	wallTextLabel	optional	yes
(2,9)	displayObject	optional	yes
(5,28)	mrObject	optional**	yes
(5,28)(2,1)	title	optional	no

TagPath	Element	Occurrence	Repeatability
(5,28)(2,2)	creator	optional	no
(5,28)(2,32)	contributor	optional	yes
(5,28)(2,8)	date	optional	no
(5,28)(2,17)	description	optional	no
(5,28)(2,22)	type	optional	no
(5,28)(2,20)	language	optional	no
(5,28)(2,21)	subject	optional	yes
(5,28)(2,31)	publisher	optional	no
(5,28)(2,27)	format	optional	no
(5,28)(2,33)	source	optional	no
(5,28)(2,30)	relation	optional	no
(5,28)(2,34)	coverage	optional	no
(5,28)(2,29)	rights	optional	no
(5,28)(5,29)	rendition	optional**	yes
(5,28)(5,29)(5,30)	resource	optional	no
(5,28)(5,29)(2,1)	title	optional	no
(5,28)(5,29)(2,2)	creator	optional	no
(5,28)(5,29)(2,32)	contributor	optional	yes
(5,28)(5,29)(2,8)	date	optional	no
(5,28)(5,29)(2,17)	description	optional	no
(5,28)(5,29)(2,22)	type	optional	no
(5,28)(5,29)(2,20)	language	optional	no
(5,28)(5,29)(2,21)	subject	optional	yes
(5,28)(5,29)(2,31)	publisher	optional	no
(5,28)(5,29)(2,27)	format	optional	no
(5,28)(5,29)(2,33)	source	optional	no
(5,28)(5,29)(2,30)	relation	optional	no
(5,28)(5,29)(2,34)	coverage	optional	no
(5,28)(5,29)(2,29)	rights	optional	no

* For each retrieval record, one of the following elements must be present:

(5,32) objectTitle (if the record is an object record or an image with text record)

(5,33) bibliographicTitle (if the record is a bibliographic record)

** If the element *mrObject* occurs, at least one occurrence of *rendition* and its subelement *resource* is mandatory.

6.4.3.3. The Abstract Record Structure for the Retrieval Record

The Abstract Record Structure for the Retrieval Record (below) addresses important goals of the CIMI Profile. First, it maintains alignment with the *Digital Collections Profile* in that it adopts a structure of that Profile's Object Descriptive Record. The resources addressed by the CIMI Profile are modeled as digital objects. The CIMI Profile treats all content and descriptive information as digital objects, and to this extent does not exploit fully the functions of the Digital Collections Profile (e.g., for navigation of collections).

Second, the tagSet-G and tagSet-M elements at the beginning of the retrieval record allow semantic interoperability with Z39.50 clients that have no knowledge of either the Digital Collections Schema or the CIMI Schema. CIMI Z-servers will include, at the beginning of a retrieval record, the tagSet-G elements corresponding to the Dublin Core elements as listed below. Other tagSet-G and tagSet-M elements can occur at the beginning or elsewhere in the the record.

The Abstract Record Structure for the Retrieval Record uses the tagSet-M element *schemaIdentifier* to indicate interoperability boundary points as described in Section 6.4.3.1.

The following table provides usage guidance and/or required values for selected schema elements in the Abstract Record Structure.

Element Name (tagPath)	Usage Guidelines/Required Values
identifier (2,28)	The server can choose the data to return in this element. For example, it may return a URL for a rendition of an image or a pointer to other pages that are appropriate from the perspective of the server.
schemaIdentifier (1,1)	First occurrence of element in retrieval record has <i>Required Value = OID of Digital Collections Schema</i> (1.2.840.10003.13.3). Must occur
typeOfDescriptiveRecord (4,1)	<i>Required Value = 2</i> (descriptive object record)
typeOfObject (4,4)(4,12)	<i>Required Value = 1</i> (object is a digital object)
categoryOfObject (4,4)(4,13)	<i>Permissible Values:</i> <i>cimi: unspecified</i> <i>cimi: cataloging record</i> <i>cimi: image record</i> <i>cimi: object record</i>
schemaIdentifier (4,4)(4,14)(4,29)(1,1)	Second occurrence of element in retrieval record has <i>Required Value = OID of CIMI Schema</i> (1.2.840.10003.13.5)
displayObject (4,4)(4,14)(4,29)(2,9)	appliedVariant may be used with element; default is text
mrObject (4,4)(4,14)(4,29)(5,28)	Occurs for each "image" associated with record
rendition (4,4)(4,14)(4,29)(5,28)(5,29)	Occurs for each available resolution of each "image" (mrObject)
resource (4,4)(4,14)(4,29)(5,28)(5,29)(5,30)	appliedVariant may be used with element

The following Abstract Record Structure for the Retrieval Record describes the layout and order of the GRS record.

TagPath	Element	Occurrence	Repeatability
(1,14)	localControlNumber	mandatory	no
(2,1)	title	optional	no
(2,2)	creator	optional	no
(2,32)	contributor	optional	yes
(2,8)	date	optional	no
(2,17)	description	optional	no
(2,28)	identifier	optional	no
(2,22)	type	optional	no
(2,20)	language	optional	no
(2,21)	subject	optional	yes
(2,31)	publisher	optional	no
(2,27)	format	optional	no
(2,33)	source	optional	no
(2,30)	relation	optional	no
(2,34)	coverage	optional	no
(2,29)	rights	optional	no
(1,1)	schemaIdentifier	mandatory	no
(4,1)	typeOfDescriptiveRecord	mandatory	no
(4,4)	objectInfo	mandatory	no

TagPath	Element	Occurrence	Repeatability
(4,4)(4,12)	typeOfObject	optional	no
(4,4)(4,13)	categoryOfObject	optional	no
(4,4)(4,14)	digitalObject	mandatory	no
(4,4)(4,14)(4,29)	actualDO	mandatory	no
(4,4)(4,14)(4,29)(1,1)	schemaIdentifier	mandatory	no
(4,4)(4,14)(4,29)(5,31)	objectName	optional	yes
(4,4)(4,14)(4,29)(5,32)	objectTitle	optional*	no
(4,4)(4,14)(4,29)(5,33)	bibliographicTitle	optional*	no
(4,4)(4,14)(4,29)(5,49)	creatorGeneral	optional	no
(4,4)(4,14)(4,29)(5,36)	creatorInfo	mandatory	yes
(4,4)(4,14)(4,29)(5,36)(2,7)	name	mandatory	no
(4,4)(4,14)(4,29)(5,36)(5,8)	dateOfBirth	optional	no
(4,4)(4,14)(4,29)(5,36)(5,9)	dateOfDeath	optional	no
(4,4)(4,14)(4,29)(5,36)(5,4)	nationalityCultureRace	optional	no
(4,4)(4,14)(4,29)(5,36)(5,10)	role	optional	no
(4,4)(4,14)(4,29)(5,60)	fieldCollector	optional	yes
(4,4)(4,14)(4,29)(5,1)	repositoryName	optional	no
(4,4)(4,14)(4,29)(5,26)	repositoryPlace	optional	no
(4,4)(4,14)(4,29)(5,38)	owner	optional	yes
(4,4)(4,14)(4,29)(5,7)	creditLine	optional	no
(4,4)(4,14)(4,29)(5,2)	subject	optional	yes
(4,4)(4,14)(4,29)(2,31)	publisher	optional	no
(4,4)(4,14)(4,29)(5,3)	objectID	mandatory	no
(4,4)(4,14)(4,29)(5,5)	materialMedium	optional	yes
(4,4)(4,14)(4,29)(5,12)	processTechnique	optional	yes
(4,4)(4,14)(4,29)(5,13)	dimensions	optional	yes
(4,4)(4,14)(4,29)(5,11)	placeOfOrigin	optional	no
(4,4)(4,14)(4,29)(5,45)	dateOfOrigin	optional	no
(4,4)(4,14)(4,29)(5,61)	dateCollected	optional	no
(4,4)(4,14)(4,29)(5,62)	agePeriod	optional	yes
(4,4)(4,14)(4,29)(5,63)	typeSpecimen	optional	no
(4,4)(4,14)(4,29)(5,14)	stylePeriod	optional	yes
(4,4)(4,14)(4,29)(5,65)	periodName	optional	yes
(4,4)(4,14)(4,29)(5,15)	provenance	optional	yes
(4,4)(4,14)(4,29)(5,17)	quantity	optional	yes
(4,4)(4,14)(4,29)(5,18)	award	optional	yes
(4,4)(4,14)(4,29)(5,20)	collection	optional	yes
(4,4)(4,14)(4,29)(5,22)	inscriptionMark	optional	yes
(4,4)(4,14)(4,29)(5,51)	objectLanguage	optional	yes
(4,4)(4,14)(4,29)(5,52)	condition	optional	yes
(4,4)(4,14)(4,29)(5,53)	physicalDescription	optional	yes
(4,4)(4,14)(4,29)(5,55)	protectionStatus	optional	yes
(4,4)(4,14)(4,29)(5,56)	protectionDate	optional	yes
(4,4)(4,14)(4,29)(5,57)	spatialReferencingSystem	optional	yes
(4,4)(4,14)(4,29)(5,58)	x-coordinateInSpatialReferencingSystem	optional	yes
(4,4)(4,14)(4,29)(5,59)	y-coordinateInSpatialReferencingSystem	optional	yes
(4,4)(4,14)(4,29)(5,64)	address	optional	yes
(4,4)(4,14)(4,29)(5,16)	relatedObjects	optional	yes
(4,4)(4,14)(4,29)(5,35)	relatedTextualReferences	optional	yes
(4,4)(4,14)(4,29)(5,50)	associationGeneral	optional	yes
(4,4)(4,14)(4,29)(5,24)	association	optional	yes

TagPath	Element	Occurrence	Repeatability
(4,4)(4,14)(4,29)(5,24)(2,7)	name	optional	yes
(4,4)(4,14)(4,29)(5,24)(5,41)	place	optional	yes
(4,4)(4,14)(4,29)(5,24)(5,42)	event	optional	yes
(4,4)(4,14)(4,29)(5,24)(5,43)	activity	optional	yes
(4,4)(4,14)(4,29)(5,24)(2,17)	description	optional	yes
(4,4)(4,14)(4,29)(5,39)	contentGeneral	optional	yes
(4,4)(4,14)(4,29)(5,25)	content	optional	yes
(4,4)(4,14)(4,29)(5,25)(2,7)	name	optional	yes
(4,4)(4,14)(4,29)(5,25)(5,41)	place	optional	yes
(4,4)(4,14)(4,29)(5,25)(5,42)	event	optional	yes
(4,4)(4,14)(4,29)(5,25)(5,43)	activity	optional	yes
(4,4)(4,14)(4,29)(5,25)(2,17)	description	optional	yes
(4,4)(4,14)(4,29)(5,46)	contextHistorical	optional	yes
(4,4)(4,14)(4,29)(5,47)	contextArchaeological	optional	yes
(4,4)(4,14)(4,29)(5,48)	copyrightRestriction	optional	yes
(4,4)(4,14)(4,29)(5,54)	wallTextLabel	optional	yes
(4,4)(4,14)(4,29)(2,9)	displayObject	optional	yes
(4,4)(4,14)(4,29)(5,28)	mrObject	optional**	yes
(4,4)(4,14)(4,29)(5,28)(2,1)	title	optional	no
(4,4)(4,14)(4,29)(5,28)(2,2)	creator	optional	no
(4,4)(4,14)(4,29)(5,28)(2,32)	contributor	optional	yes
(4,4)(4,14)(4,29)(5,28)(2,8)	date	optional	no
(4,4)(4,14)(4,29)(5,28)(2,17)	description	optional	no
(4,4)(4,14)(4,29)(5,28)(2,22)	type	optional	no
(4,4)(4,14)(4,29)(5,28)(2,20)	language	optional	no
(4,4)(4,14)(4,29)(5,28)(2,21)	subject	optional	yes
(4,4)(4,14)(4,29)(5,28)(2,31)	publisher	optional	no
(4,4)(4,14)(4,29)(5,28)(2,27)	format	optional	no
(4,4)(4,14)(4,29)(5,28)(2,33)	source	optional	no
(4,4)(4,14)(4,29)(5,28)(2,30)	relation	optional	no
(4,4)(4,14)(4,29)(5,28)(2,34)	coverage	optional	no
(4,4)(4,14)(4,29)(5,28)(2,29)	rights	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)	rendition	optional**	yes
(4,4)(4,14)(4,29)(5,28)(5,29)(5,30)	resource	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,1)	title	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,2)	creator	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,32)	contributor	optional	yes
(4,4)(4,14)(4,29)(5,28)(5,29)(2,8)	date	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,17)	description	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,22)	type	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,20)	language	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,21)	subject	optional	yes
(4,4)(4,14)(4,29)(5,28)(5,29)(2,31)	publisher	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,27)	format	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,33)	source	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,30)	relation	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,34)	coverage	optional	no
(4,4)(4,14)(4,29)(5,28)(5,29)(2,29)	rights	optional	no

* For each retrieval record, one of the following elements must be present:

(5,32) objectTitle (if the record is an object record or an image with text record)

(5,33) bibliographicTitle (if the record is a bibliographic record)

** If the element *mrObject* occurs, at least one occurrence of *rendition* and its subelement *resource* is mandatory.

6.4.3.4. Element Set Name

The Z-server creates a result set in response to a query. The result set is a set of pointers to records in one or more databases. An element set name identifies a group of elements in a database record for the Z-server to return to the Z-client. The CIMI Profile defines the following three element set names for the Abstract Record Structure for the Retrieval Record (element set names are literal strings):

- *b*
- *mb*
- *f*

6.4.3.4.1. Element Set Name *b*

The element set name *b* (i.e. brief) is intended to retrieve a form of the database record comprised of tagSet-G elements at the top of the Abstract Record Structure for the Retrieval Record. Retrieval of this form of the record corresponds to a generic level of resource discovery and retrieval utilizing the Dublin Core Metadata Elements. See Section 6.6. Conformance. Other tagSet-G and tagSet-M elements can be included by the Z-server in the retrieval record. The following elements comprise element set name *b*:

TagPath	Element	Repeatability
(1,14)	localControlNumber	no
(2,1)	title	no
(2,2)	creator	no
(2,32)	contributor	yes
(2,8)	date	no
(2,17)	description	no
(2,28)	identifier	no
(2,22)	type	no
(2,20)	language	no
(2,21)	subject	yes
(2,31)	publisher	no
(2,27)	format	no
(2,33)	source	no
(2,30)	relation	no
(2,34)	coverage	no
(2,29)	rights	no

6.4.3.4.2. Element Set Name *mb*

The element set name *mb* is intended to retrieve a brief form of the database record according to common practice in museum systems (i.e., a **m**useum **b**rief record). The purpose of this brief form is to provide CIMI Z-clients with sufficient data elements to construct a *tombstone* record.

If the described resource has one or more associated images, Z-servers may include one or more *mrObject* elements and associated *rendition* elements for each image available. Servers will send details of all available images and image renditions in element set name *mb*. Occurrences of *rendition* should be ordered in increasing resolution, with lowest/smallest rendition occurring first.

The Z-server may include tagSet-G and tagSet-M elements in the retrieval record.

TagPath	Element	Repeatability
(1,14)	localControlNumber	No
(1,1)	schemaIdentifier	No
(4,1)	typeOfDescriptiveRecord	No
(4,4)	objectInfo	No
(4,4)(4,12)	typeOfObject	No
(4,4)(4,13)	categoryOfObject	No
(4,4)(4,14)	digitalObject	No
(4,4)(4,14)(4,29)	actualDO	No
(4,4)(4,14)(4,29)(1,1)	schemaIdentifier	No
(4,4)(4,14)(4,29)(5,31)	objectName	No
(4,4)(4,14)(4,29)(5,32)	objectTitle	No
(4,4)(4,14)(4,29)(5,33)	bibliographicTitle	No
(4,4)(4,14)(4,29)(5,36)	creatorInfo	Yes
(4,4)(4,14)(4,29)(5,36)(2,7)	name	No
(4,4)(4,14)(4,29)(5,36)(5,8)	dateOfBirth	No
(4,4)(4,14)(4,29)(5,36)(5,9)	dateOfDeath	No
(4,4)(4,14)(4,29)(5,36)(5,4)	nationalityCultureRace	No
(4,4)(4,14)(4,29)(5,60)	fieldCollector	Yes
(4,4)(4,14)(4,29)(5,61)	dateCollected	No
(4,4)(4,14)(4,29)(5,62)	agePeriod	Yes
(4,4)(4,14)(4,29)(5,63)	typeSpecimen	No
(4,4)(4,14)(4,29)(5,38)	owner	No
(4,4)(4,14)(4,29)(5,3)	objectID	No
(4,4)(4,14)(4,29)(5,5)	materialMedium	No
(4,4)(4,14)(4,29)(5,13)	dimensions	No
(4,4)(4,14)(4,29)(5,11)	placeOfOrigin	No
(4,4)(4,14)(4,29)(5,14)	stylePeriod	Yes
(4,4)(4,14)(4,29)(5,28)	mrObject	Yes
... *		

* include subelements for *mrObject* per Abstract Record Structure as warranted

6.4.3.4.3. Element Set Name *f*

The element set name *f* (i.e., full) includes all available database record elements. Those database record elements that can be tagged using the available tags from tagSet-G, tagSet-M, tagSet-Collections, and tagSet-CIMI should be so tagged. Additional elements returned by the server should be packaged into the element *displayObject*, or the Z-server can use TagType 3 with string tags for locally defined elements. The client does not process the data in *displayObject* or string tags but simply displays the information to the user.

6.4.3.4.4. Guidance for the Retrieval Record

The following is implementation guidance for a CIMI Z-server's behavior when no field exists in a database for an element requested in an element set name.

The following are the three possible cases:

- A field exists in the database and contains data
- A field exists in the database but contains no data
- No field exists in the database.

The first case presents no problem. The CIMI Z-server returns a GRS element(s) with the appropriate data.

For the second case, the CIMI Z-server returns the GRS element and for *ElementData* returns *elementEmpty*. This explicitly tells the CIMI Z-client that there is no data in the field.

In the third case, the CIMI Z-server may respond in two ways:

- The CIMI Z-server returns the GRS element and for *ElementData* returns *elementNotThere*. This explicitly tells the CIMI Z-client that there is no database field in the record.
- The CIMI Z-server does not return the GRS element.

The CIMI Z-client will interpret these two CIMI Z-server responses in the same way, namely, that there is no database field in the record associated with the GRS element.

6.4.3.5. Record Syntaxes

The CIMI Profile requires the support of the following record syntax defined by Z39.50-1995:

- GRS-1, Generic Record Syntax (OID = 1.2.840.10003.5.105)

For interchange, GRS-1 records are to be treated as the complete and canonical representation.

For purposes of interoperability, servers may support other record syntaxes including:

- USMARC (OID = 1.2.840.10003.5.10) — an implementation of ANSI/NISO Z39.2 [9] which is maintained by the Library of Congress [13]
- SUTRS, Simple Unstructured Text Record Syntax (OID = 1.2.840.10003.5.101) — defined in Z39.50.

The recommendations on supporting the USMARC record syntax can be found in Section 6.6. Conformance.

When a server is unable to return an object in the requested record syntax, the server should return a diagnostic (e.g., Bib-1 Diagnostic #238 – Record not available in requested syntax; Bib-1 Diagnostic #239 – Record syntax not supported).

6.4.3.5.1. Use of GRS-1

Usage of record syntax GRS-1 is defined as follows. In the GRS-1 main structure, the following parameters must be supported:

tagType
tagValue
tagOccurrence
content
appliedVariant

The GRS-1 element appliedVariant may be used in retrieval record elements including:

- *displayObject*
- *resource*

The following defines how appliedVariant is used with each of these elements.

For Variant	Variant is a sequence of the following
variantSetId	Always Variant-1
class	Always supplied
type	Always supplied
value	Always supplied

Variant information for *displayObject*

Variant information may be supplied for *displayObject*. If no variant information is supplied, the content of the element is assumed to be text.

variantSetId =	1.2.840.10003.12.1	(variant-1)
class =	2	BodyPartType
type =	1 or 2	ianaType or Z39.50Type
value =	InternationalString or OctetString	

variantSetId =	1.2.840.10003.12.1	(variant-1)
class =	9	(miscellaneous)
type =	5	(content is a pointer, e.g., in the form of a URL)
value =	Null	

Variant information for *resource*

Variant information is provided to indicate the type and size of the "image." Type is conveyed through a MIME-type value. Size is conveyed through the use of a string value or actual size in intUnit.

The server uses the following appliedVariant when the content of the element *resource* is a pointer to the image:

variantSetId =	1.2.840.10003.12.1	(variant-1)
class	9	(miscellaneous)
type	5	(content is a pointer, e.g., in the form of a URL)
value	Null	

To provide information about the MIME-type of the image:

variantSetId =	1.2.840.10003.12.1	(variant-1)
class =	2	(BodyPartType)
type =	1	(ianaType)
value =	InternationalString	

To provide information about the size of the image using an enumerated set of string values:

variantSetId =	1.2.840.10003.12.1	(variant-1)
class =	7	(meta-data returned)
type =	6	(variant description)
value =	InternationalString	

Allowable string values for the variant description that addresses the size of the image are:

- thumbnail
- wallet
- snapshot
- standard
- other

To provide information about the actual size of the image:

variantSetId =	1.2.840.10003.12.1	(variant-1)
class =	7	(meta-data returned)
type =	2	(size)
value =	IntUnit	(consists of Integer and Unit)

Unit is defined as (see <<http://lcweb.loc.gov/z3950/agency/defs/units/zunits.html>>)

- unitSystem = Z3950
- unitType = information unit
- unit = byte

To provide information about the cost of the image:

variantSetId =	1.2.840.10003.12.1	(variant-1)
class =	7	(meta-data returned)
type =	1	(cost)
value =	IntUnit	(consists of Integer and Unit)

Unit is defined as (see <http://lcweb.loc.gov/z3950/agency/defs/units/zunits.html>)

- unitSystem = Z3950
- unitType = iso4217-1990
- unit = currency code from ISO 4217-1990

6.4.3.6. Retrieval of Images

The CIMI Profile, Release 1.0., does not address encoding of images (or other binary data) directly in GRS-1 for retrieval via Z39.50. The assumption is that CIMI Z-servers will provide CIMI Z-clients information about available images associated with object records and available renditions of those images. The repeatable element *rendition* contains a subelement *resource* that will contain a HTTP URL or the actual bit stream of data for a specific rendition of an image.

This CIMI Profile provide the following guidance regarding the sizes of images that CIMI Z-servers may provide to CIMI Z-clients:

- thumbnail: maximum size 96x96 (corresponds to PCD Base/64)
- wallet: maximum size 192x192 quarter screen (corresponds to PCD Base/16)
- snapshot: maximum size 384x384 (corresponds to PCD Base/4)
- standard: maximum size 768x768 (corresponds to PCD Base)
- other: dimension not specified.

Renditions are to be ordered in the GRS record with the smallest size/lowest resolution listed in the first occurrence of *rendition*. A CIMI Z-client, however, should look at the appliedVariant information for *resource* to determine if the rendition is an appropriate size for its use.

6.4.4. Close

The CIMI Profile requires clients and servers to recognize the Close protocol data unit (PDU), but the actual use of the Close Service is optional.

6.5. Diagnostic Messages

The Implementors Agreement requires support for Diagnostic Set Bib-1 (OID = 1.2.840.10003.4.1).

CIMI Z-servers will support the diagnostic 1024: Unsupported Attribute. This diagnostic will be used with addInfo, which will include an unstructured string indicating the object identifier of the attribute set id, the numeric value of the attribute type, and the numeric value of the attribute.

6.6. Conformance

The CIMI Profile defines five Conformance Levels: Levels 0,1,2,3,4. These are associated with search and retrieval functionality supported by CIMI Z-clients and Z-servers. The extent of attribute values and element set names supported defines the Conformance Levels (i.e., a server supports a certain set of attribute values; a server creates a retrieval record using one or more element set names). In addition to specifying a group of Use attributes and one or more element set names to support at each Conformance Level, there is an indication of the Z39.50 Objects (see Section 6.2) required for support by CIMI Z-clients and Z-servers. Conformance Levels are cascading in that Conformance Level N+1 inherits the functionality for Conformance Level N.

This approach to conformance addresses two key concerns. First, Conformance Levels 0 and 1 provide a foundation for interoperable cross-domain resource discovery. This level results in relatively "coarse grain" search and retrieval.

Second, the resources accessible by CIMI Z-clients and Z-servers are diverse in database richness, structure, the extent to which fields in the database are populated with data, and the extent of access points supported in specific databases. Specifying multiple Conformance Levels reflects the Profile's sensitivity to this heterogeneous situation.

Support for attributes in this context means that the server will recognize the Use attributes, and a search using the Use attributes listed for a Conformance Level will always result in a valid result set (which could contain 0 hits). This implies that all CIMI conformant implementations must have search capabilities for the listed Use attributes for a specific conformance level.

6.6.1. Interoperability and USMARC

Implementation at Conformance Levels 0 and 1 puts the least burden on the installed base of Z39.50 implementations to interact with CIMI Z-clients and CIMI Z-servers. Level 0 can be considered the easiest Conformance Level to support and implement; it provides support for simple searching, and returns a simple, brief record comprised of tagSet-G elements.

Although the CIMI Profile requires CIMI Z-clients and Z-servers to support GRS-1, the Profile recommends that CIMI implementations consider support for the USMARC record syntax. CIMI Z-clients and Z-servers should also be prepared for interactions with implementations that understand the Simple Unstructured Text Record Syntax (SUTRS). Support for USMARC and SUTRS record syntaxes is optional at all Conformance Levels.

Identifying optional support for USMARC in the CIMI Profile addresses CIMI's interest in promoting wider interoperability with installed Z39.50 implementations, in particular, Z39.50 bibliographic clients and servers. Since many Z39.50 bibliographic implementations support only Version 2, the Bib-1 Attribute Set, and the USMARC record syntax, the CIMI Profile specifies how interoperability with those implementations can be achieved at a level of simple search and retrieval. CIMI Profile implementors who plan to support searches from Z39.50 bibliographic clients and/or retrieval from Z39.50 bibliographic servers should strongly consider supporting USMARC record syntax. Appendix D provides a mapping between element set name *b* elements and USMARC fields.

6.6.2. Conformance Level 0

Conformance Level 0 offers a mode of interaction between CIMI Z-clients and CIMI Z-servers for basic and generic search and retrieval. Use attributes Who, What, When, and Where support simple searching for cultural heritage information on CIMI Z-servers. This Conformance Level allows Z39.50 bibliographic clients to conduct basic Author, Title, and Subject searching of CIMI Z-servers through use of Bib-1 attribute values. CIMI Z-clients can also search Z39.50 bibliographic servers for similar search and retrieval. Conformance Level 0 requires support of a minimum set of attributes, one element set name, and several Z39.50 Objects. CIMI Z-servers should be prepared to receive a query with a Bib-1 OID and the Bib-1 Use attributes listed below. Support for USMARC and SUTRS record syntaxes are optional.

Use Attributes:

CIMI-1 Use Attribute Value	Name	Bib-1 Use Attribute Value	Name
4	title	4	title
7	ISBN	7	ISBN
8	ISSN	8	ISSN
12	local number	12	local number
21	subject heading	21	subject heading
31	date of publication	31	date of publication
1003	author	1003	author
1004	personal author	1004	personal author
1016	any	1016	any
2046	who		
2047	what		
2048	when		
2049	where		

Element Set Name:

Level 0 requires that clients and servers can request and return all elements in element set name *b* (see Section 6.4.3.4.1.).

Z39.50 Objects:

Object	OID	Client	Server
Bib-1 attribute set	1.2.840.10003.3.1	X	X
CIMI-1 attribute set	1.2.840.10003.3.8	X	X
Bib-1 diagnostic set	1.2.840.10003.4.1	X	X
GRS-1 record syntax	1.2.840.10003.5.105	X	X
SUTRS record syntax	1.2.840.10003.5.101	optional	optional
USMARC record syntax	1.2.840.10003.5.10	optional	optional
TagSet-M	1.2.840.10003.14.1	X	X
TagSet-G	1.2.840.10003.14.2	X	X

6.6.3. Conformance Level 1

Conformance Level 1 provides "coarse grain" or generic-level search and retrieval for purposes of resource discovery. Network-accessible resources are viewed through the lens of the Dublin Core Metadata Elements. Conformance Level 1 allows CIMI Z-clients and non-CIMI Z-clients to use Dublin Core Metadata as concepts upon which to search (i.e., access points) and as elements in which to package database information into a retrieval record. A CIMI Z39.50 client must use the CIMI-1 Use attribute values below and send the CIMI-1 OID in a query. A non-CIMI Z-client can use the Bib-1 Use attributes below and send the Bib-1 OID in a query. A non-CIMI Z39.50 client that supports GRS-1 can interoperate with a CIMI Z-server since Conformance Level 1 only requires those clients to process tagSet-G and tagSet-M elements in a retrieval record. Conformance Level 1 corresponds to the generic level of semantic interoperability discussed in Section 6.4.3.1. If a Dublin Core Attribute Set becomes available, non-CIMI Z39.50 clients will be able to use those attributes for searching and will be required to know nothing about the CIMI-1 Attribute Set.

Use Attributes:

CIMI-1 Use Attribute Value	Name	Bib-1 Use Attribute Value	Name
12	local number	12	localNumber
2051	DC-title	4	title
2052	DC-creator	1003	author
2053	DC-subject	21	subjectHeading
2054	DC-description	62	abstract
2055	DC-publisher	1018	publisher
2056	DC-contributor	1003	author
2057	DC-date	31	date
2058	DC-type	1031	materialType
2059	DC-format		
2060	DC-identifier	1032	doc-id
2061	DC-source		

CIMI-1 Use Attribute Value	Name	Bib-1 Use Attribute Value	Name
2062	DC-language	54	codeLanguage
2063	DC-relation		
2064	DC-coverage		
2065	DC-rights management		

Element Set Name:

Level 1 requires that clients and servers can request and return all elements in element set name *b* (see Section 6.4.3.4.1.).

Z39.50 Objects:

Object	OID	Client	Server
Bib-1 attribute set	1.2.840.10003.3.1	X	X
CIMI-1 attribute set	1.2.840.10003.3.8	X	X
Bib-1 diagnostic set	1.2.840.10003.4.1	X	X
GRS-1 record syntax	1.2.840.10003.5.105	X	X
SUTRS record syntax	1.2.840.10003.5.101	optional	optional
USMARC record syntax	1.2.840.10003.5.10	optional	optional
TagSet-M	1.2.840.10003.14.1	X	X
TagSet-G	1.2.840.10003.14.2	X	X

6.6.4. Conformance Level 2

Conformance Level 2 is unspecified in this release of the Profile. When specified, Conformance Level 2 will address more extensive use of the Digital Collections Profile. Conformance Level 2 corresponds to the Digital Collections level of semantic interoperability discussed in Section 6.4.3.1.

6.6.5. Conformance Level 3

Conformance Level 3 provides for more sophisticated, cultural heritage information-related search and retrieval. CIMI Z-clients and Z-servers must be both Digital Collection-Schema and CIMI-Schema aware. Conformance Level 3 retrieval allows CIMI Z-clients to receive sufficient database elements to build typical brief record views of museum data (e.g., tombstone). Conformance Level 3 corresponds to the CIMI level of semantic interoperability discussed in Section 6.4.3.1.

Use Attributes:

Value	Name
12	local number
2035	creatorName
2036	creatorDateOfBirth
2037	creatorDateOfDeath
2009	creatorNationalityCultureRace
2070	fieldCollector
2071	dateCollected
2072	agePeriod
2073	typeSpecimen
2008	materialMedium

Value	Name
2024	objectID
2032	objectName
2033	objectTitle
2026	owner
2023	placeOfOrigin
2017	stylePeriod

Element Set Name:

Level 3 requires that clients and servers can request and return all elements in element set name *mb* (see Section 6.4.3.4.2.).

Z39.50 Objects:

Object	OID	Client	Server
Bib-1 attribute set	1.2.840.10003.3.1	X	X
CIMI-1 attribute set	1.2.840.10003.3.8	X	X
Bib-1 diagnostic set	1.2.840.10003.4.1	X	X
GRS-1 record syntax	1.2.840.10003.5.105	X	X
SUTRS record syntax	1.2.840.10003.5.101	optional	optional
USMARC record syntax	1.2.840.10003.5.10	optional	optional
Digital Collections Schema	1.2.840.10003.13.3	X	X
CIMI Schema	1.2.840.10003.13.5	X	X
TagSet-M	1.2.840.10003.14.1	X	X
TagSet-G	1.2.840.10003.14.2	X	X
TagSet-Collections	1.2.840.10003.14.5	X	X
TagSet-CIMI	1.2.840.10003.14.6	X	X

6.6.6. Conformance Level 4

Conformance Level 4 requires CIMI Z-clients and Z-servers to support the CIMI-1 Attribute Set and element set name *f*. Conformance at Level 4 provides the richest search and retrieval of cultural heritage information resources. Conformance Level 4 corresponds to CIMI level semantic interoperability discussed in Section 6.4.3.1

APPENDIX A

CIMI-1 Attribute Set

The CIMI Profile specifies a Z39.50 attribute set, the CIMI-1 Attribute Set, for use in searching databases of museum information, databases containing cataloging records, image databases, and other resources.

Appendix B provides guidance for using attribute types and combining attribute types and values. Appendix C provides semantics for the Use attribute values specified in CIMI-1.

Note: The publication of the CIMI Profile, Release 1.0, coincided with important activities within the Z39.50 community related to attribute sets, including the adoption of a Attribute Architecture for new attribute sets. Discussions are underway concerning the development of a Dublin Core attribute set, the incorporation or mapping of Dublin Core elements into Bib-1, and other changes. CIMI will monitor these developments for their effects on CIMI-1.

Object Identifier

The OID for CIMI-1 is 1.2.840.10003.3.8.

Attribute Types

CIMI-1 imports the following types from the Bib-1 Attribute Set defined in Z39.50-1995:

Type	Name	Restrictions, Constraints
1	Use	all values defined in Z39.50 Bib-1 are valid in this attribute set (but see below)
2	Relation	all values defined in Z39.50 Bib-1
3	Position	all values defined in Z39.50 Bib-1
4	Structure	all values defined in Z39.50 Bib-1
5	Truncation	all values defined in Z39.50 Bib-1
6	Completeness	all values defined in Z39.50 Bib-1

CIMI-1 defines the following attribute type:

Type	Name	Definition
101	Authority	a value identifying the authoritative source from which a term is taken

Values for Attribute Type 1 (Use)

CIMI-1 imports a small selection of Bib-1 Use attributes to provide basic Author-Title-Subject searching of bibliographic databases by CIMI Z-clients and to support searching of CIMI Z-servers by bibliographic-oriented Z39.50 clients that do not support the CIMI Profile. CIMI Z-servers should be prepared to receive the Bib-1 OID with these Use attribute values and receive the CIMI-1 OID with these Use attribute values. The selection of Bib-1 Use attributes in CIMI-1 is based in part on emerging consensus within the Conference of European National Libraries (CENL) as documented in the *Z39.50 Bib-1 Attribute Set Profile for CENL* <http://linnea.helsinki.fi/z3950/cenl_profile.html>, which in turn is closely related to the U.S. *ATS-1 Profile* <<http://lcweb.loc.gov/z3950/agency/profiles/ats.html>>. Both profiles address semantic interoperability between bibliographic Z39.50 clients and servers. Adopting these Bib-1 Use attributes in CIMI-1 increases the likelihood of semantic interoperability between those Z39.50 clients and servers and CIMI Z-clients and Z-servers.

CIMI–1 defines new Use attributes that allow searching of cultural heritage information resources. CIMI–1 also defines Use attribute values to respond to requirements of the Aquarelle Project and reserves a block of Use attribute values (3010–3999) for future definition by implementors of that project.

CIMI–1 defines Use attributes values (2051–2065) that correspond to the Dublin Core Metadata Elements to support interoperable, cross–domain resource discovery. In addition, Bib–1 Use attributes values 31, 54, 62, 1018, 1031, and 1032 alternatively may be used by Z39.50 bibliographic clients for searching on Dublin Core Elements date, language, description, publisher, type, and identifier.

Only one value of a Use attribute may occur in an attribute list.

The CIMI Profile recommends that queries restrict their use of imported Bib–1 Use attribute values to the following:

Value	Name
4	title
7	ISBN
8	ISSN
12	local number
21	subject heading
31	date of publication
54	code language
58	name geographic
62	abstract
1003	author
1004	personal author
1016	any
1018	publisher
1031	materialType
1032	doc–id

CIMI–1 defines the following values for attribute type 1 (Use). These attribute values are numbered in an unused number space of Bib–1. Attribute values that are designated as **reserved** had been used in prototype implementations of the CIMI Profile. The reuse of these attribute values will be considered in future releases of the Profile. Local implementations may define Use attributes for **local use** and assign values in the 5000–7999 range.

Value	Name
2000	award
2001	reserved
2002	collection
2003	reserved
2004	copyrightRestriction
2005	creditLine
2006	reserved
2007	inscriptionMark
2008	materialMedium
2009	creatorNationalityCultureRace
2010	reserved
2011	reserved
2012	processTechnique
2013	reserved
2014	creatorRole
2015	reserved

Value	Name
2016	reserved
2017	stylePeriod
2018	reserved
2019	reserved
2020	image
2021	reserved
2022	dateOfOrigin
2023	placeOfOrigin
2024	objectID
2025	reserved
2026	owner
2027	repositoryName
2028	repositoryPlace
2029	provenance
2030	contentGeneral
2031	reserved
2032	objectName
2033	objectTitle
2034	relatedTextualReferences
2035	creatorName
2036	creatorDateOfBirth
2037	creatorDateOfDeath
2038	contextHistorical
2039	contextArchaeological
2040	subject
2041	creatorGeneral
2042	associationGeneral
2043	objectLanguage*
2044	condition*
2045	physicalDescription*
2046	who
2047	what
2048	when
2049	where
[2051–2065]	<i>see below</i>
2070	fieldCollector
2071	dateCollected
2072	agePeriod
2073	typeSpecimen
3000	protectionStatus*
3001	protectionDate*
3002	reserved
3003	spatialReferencingSystem*
3004	x-coordinateInReferencingSystem*
3005	y-coordinateInReferencingSystem*
3006	reserved
3007	address*
3008	reserved
3009	periodName*
3010–3999	reserved for use by the Aquarelle Project

* These Use attribute values may correspond with Aquarelle Project–specific access points that arise from the need to search for sites and buildings in architectural heritage databases. See Appendix C for semantics for these attribute values.

CIMI-1 Attribute Set defines the following values for attribute type 1 (Use) for Dublin Core Metadata Elements.

Value	Name
2051	DC-title
2052	DC-creator
2053	DC-subject
2054	DC-description
2055	DC-publisher
2056	DC-contributors
2057	DC-date
2058	DC-type
2059	DC-format
2060	DC-identifier
2061	DC-source
2062	DC-language
2063	DC-relation
2064	DC-coverage
2065	DC-rights

Values for Attribute Type 101 (Authority)

The primary source for this list of authorities is the Art Information Task Force (AITF), *Categories for the Description of Works of Art: Bibliography of Controlled Vocabulary Sources* <<http://www.gii.getty.edu/cdwa/FULLBIB.HTM>>. See that document for full citation information.

Only one value of an authority attribute may occur in an attribute list.

The server is to interpret the lack of an authority value in a query as the client "not saying" anything about the term. When such a case occurs, it is the server's choice in processing the term.

The list of values for the Authority attribute will be revised as necessary based on implementation experience and implementor requirements.

Value	Brief Name	Definition and/or Full Name of Authority
1	Non-authoritative	The client explicitly states that the term is not taken from any authoritative list
2	Local-to-server	The term is known to the client to come from an authoritative source defined by the server
3	USMARC	The term is a code taken from USMARC manuals or associated documents, such as the set of coded values for countries, languages, etc.
4	LCSH	The term is from Library of Congress Subject Headings
5	AAT	The term is from Art & Architecture Thesaurus (AAT)
6	AAT Date	The term is from "Date and Geographic Name Guidelines" in Appendix A of Chapter 3, Guide to Indexing and Cataloging with the Art & Architecture Thesaurus (AAT)
7	ACRL/RBMS Binding	The term is from Binding Terms: A Thesaurus for Use in Rare Book and Special Collections Cataloging
8	ACRL/RBMS Genre	The term is from Genre Terms: A Thesaurus for Use in Rare Book and Special Collections Cataloging
9	ACRL/RBMS Paper	The term is from Paper Terms: A Thesaurus for Use in Rare Book and Special Collections Cataloging
10	ACRL/RBMS Printing	The term is from Printing and Publishing Evidence: A Thesaurus for Use in Rare Book and Special Collections Cataloging

Value	Brief Name	Definition and/or Full Name of Authority
11	ACRL/RBMS Type	The term is from Type Evidence: A Thesaurus for Use in Rare Book and Special Collections Cataloging
12	Base Merimee	The term is from BaseMérimee: Lexique d'interrogation pour les champs: dénomination, parties constituantes, ouvrages remarquables
13	BGN	The term is from the Board on Geographic Names
14	British Archaeological	The term is from British Archaeological Thesaurus: For Use with British Archaeological Abstracts, and Other Publications in British Archaeology
15	Canadiana	The term is from Canadiana Authorities / Canadiana, vedettes d'autorité
16	Dictionarium Museologicum	The term is from Dictionarium Museologicum
17	Garnier	The term is from Thesaurus iconographique: système descriptif des représentations
18	Geosaurus	The term is from Geosystems' Thesaurus of Geoscience
19	Glass	The term is from A Subject Index for the Visual Arts
20	ICOM Costume	The term is from Vocabulary of Basic Terms for Cataloging Costume / Vocabulaire de base pour les fichiers de costume
21	ICONCLASS	The term is from ICONCLASS: An Iconographical Classification System
22	Jewish Art	The term is from Index of Jewish Art: An Iconographical Index of Hebrew Illuminated Manuscripts
23	ISO Language	The term is from ISO 639: Codes for the Representation of Names of Languages/ Codes pour la représentation des noms de langue
24	ISO Documentation	The term is from ISO 5127-1: Documentation and Information. Vocabulary. Part 1, Basic Concepts / Documentation et information. Vocabulaire. Partie 1, Notions fondamentales
25	ISO Iconic	The term is from ISO 5127-3: Documentation and Information. Part 3, Iconic Documents / Documentation et information. Vocabulaire. Partie 3, Documents iconiques
26	ISO AV	The term is from ISO 5127-11: Documentation and Information. Vocabulary. Part 11, Audio-visual Documents /Documentation et information. Vocabulaire. Partie 11, Documents audiovisuels
27	ISO Date/Time	The term is from ISO 8601: Data Elements and Interchange Formats. Information Interchange. Representation of Dates and Times
28	LC Descriptive Graphic	The term is from Descriptive Terms for Graphic Materials: Genre and Physical Characteristic Headings
29	LC Name	The term is from Library of Congress Name Authorities
30	LC Thesaurus Graphic	The term is from LC Thesaurus for Graphic Materials: Topical Terms for Subject Access
31	Moving Image Materials	The term is from Moving Image Materials: Genre Terms
32	Nomenclature	The term is from The Revised Nomenclature for Museum Cataloging: A Revised and Expanded Version of Robert G. Chenhall's System for Classifying Man-made Objects
33	Reynies	The term is from Le Mobilier domestique; vocabulaire typologique
34	TGN	The term is from Thesaurus of Geographic Names
35	Tozzer	The term is from Tozzer Index to Anthropological Subject Headings, Harvard University
36	ULAN	The term is from Union List of Artist Names
37	Villard	The term is from système descriptif des antiquités classiques
38	Yale British Artists	The term is from British Artists Authority List
1000	RCHME	The term is from the Royal Commission on the Historical Monuments of England
1001-1999	reserved	Not defined at this point. For use by Aquarelle Project implementors

APPENDIX B

CIMI-1 Attributes & Attribute Combinations

This appendix provides guidance for combining attributes in queries and on the occurrence of attribute types and default values for attribute types when they are not present in a query.

Occurrence of Attributes in Query

CIMI Z-servers should be prepared to receive a query containing only a search term and no attributes. In such cases, the server should default to behavior equivalent to receiving a search term with a Use attribute value 1016 (Any).

CIMI Z-clients should include one Use attribute value per term in a query. All other attribute types defined in the CIMI-1 Attribute Set are optional. In the case when a query contains a Use attribute value but contains no other attribute types, the recommended default for the server is:

- Type 2 Relation: Default is *equal* (value = 3)
- Type 3 Position: Default is *any position in field* (value = 3)
- Type 4 Structure: Default is *word* (value = 2)
- Type 5 Truncation: Default is *do not truncate* (value = 100)
- Type 6 Completeness: Default is *complete field* (value = 3)

Type 101 Authority has no explicit default. Instead, the server is to interpret the lack of an authority value in a query as the client "not saying" anything about the term. When such a case occurs, it is the server's choice in processing the term.

One (and only one) of each type of attribute may be sent in each operand of the Type 1 query. Z-clients can reduce ambiguity in the query by including all attributes types in a query to explicitly characterize a term. If a Z-server receives an attribute type or an attribute value it can not accept, it should reject the search with a diagnostic.

Client and server are required to support a minimum of one Boolean operator in each query .

AND and OR must be supported as Booleans in the Type 1 query. AND NOT is optional.

Attributes & Attribute Combinations

The following provides additional guidance on the attribute types. The support of attribute values, especially Use attributes, is governed by the conformance statement (see CIMI Profile, Section 6.6). Other values may be optionally supported.

Type 1 (USE)

If the database being searched has elements (and/or indexes) that match the attribute as defined, the search should succeed and the appropriate result returned. If not, the search should be failed with the appropriate diagnostic (114 Unsupported Use attribute). No mapping from one attribute to another should be done. In the absence of any prior knowledge of the target, origins are required to support sending all defined values.

Type 2 (RELATION)

Value 3 (*equal*) should be accepted for all Type 1 attributes. For Use Attributes that support structure types date, year, local number or numeric string, the following additional relation attribute values should be supported:

- 1 = *less than*
- 2 = *less than or equal*
- 4 = *greater or equal*
- 5 = *greater than*

The relation attribute value 103 (*AlwaysMatches*) can be used with Use attribute 2020 (*image*) search for occurrences of records with images. Term is Null.

Type 3 (POSITION)

Value 3 (*any position in field*) should be accepted.

Type 4 (STRUCTURE)

The following Type 4 values may be combined with the Type 1 (Use) attributes listed.

Word (Value 2) and Phrase (Value 1)

- 4 = *title*
- 7 = *ISBN*
- 8 = *ISSN*
- 21 = *subject heading*
- 54 = *Code language*
- 58 = *name geographic*
- 62 = *abstract*
- 1003 = *author*
- 1004 = *personal author*
- 1016 = *any*
- 1018 = *publisher*
- 1031 = *material type*
- 2000 = *award*
- 2002 = *collection*
- 2004 = *copyrightRestrictions*
- 2005 = *creditLine*
- 2007 = *inscriptionMark*
- 2008 = *materialMedium*
- 2009 = *creatorNationalityCultureRace*
- 2012 = *processTechnique*
- 2014 = *creatorRole*
- 2017 = *stylePeriod*
- 2023 = *placeOfOrigin*
- 2024 = *objectID*
- 2026 = *owner*
- 2027 = *repositoryName*
- 2028 = *repositoryPlace*

2029 = *provenance*
2030 = *contentGeneral*
2032 = *objectName*
2033 = *objectTitle*
2034 = *relatedTextualReferences*
2035 = *creatorName*
2038 = *contextHistorical*
2039 = *contextArchaeological*
2040 = *subject*
2041 = *creatorGeneral*
2042 = *associationGeneral*
2043 = *objectLanguage*
2044 = *condition*
2045 = *physicalDescription*
2046 = *who*
2047 = *what*
2049 = *where*
2070 = *fieldcollector*
2072 = *agePeriod*
2073 = *typeSpeciment*
3000 = *protectionStatus*
3003 = *spatialReferencingSystem*
3007 = *address*
3008 = *currentLocation*
3009 = *periodName*

Date (Value 100)

30 = *date*
31 = *date of publication*
2022 = *dateOfOrigin*
2048 = *when*
2071 = *dateCollected*
3001 = *protectionDate*

Year (Value 4)

30 = *date*
31 = *date of publication*
2022 = *dateOfOrigin*

Local Number (Value 107)

12 = *local number*

Numeric String (Value 109)

12 = *local number*
30 = *date*
31 = *date of publication*
2022 = *dateOfOrigin*
2048 = *when*
2071 = *dateCollected*
3001 = *protectionDate*

urx (Value 104)

1032 = *doc-id*

Type 5 (TRUNCATION)

Value 100 (*do not truncate*) should be accepted for all Type 1 attributes.

Type 6 (COMPLETENESS)

Value 3 (*complete field*) should be accepted.

Type 101 (AUTHORITY)

Value 1 (*non-authoritative*) should be accepted.

APPENDIX C

Semantics for Use Attributes and Schema Elements

The following table provides the semantics for selected CIMI-1 Use Attributes and associated CIMI Schema elements. In a few instances, the Element is labeled differently than the Use attribute; these are noted. Semantics for Use attributes from Bib-1 can be found in: *Attribute Set Bib-1 (Z39.50-1995): Semantics* <<ftp://ftp.loc.gov/pub/z3950/defs/bib1.txt>>. The Use attributes related to the Dublin Core Metadata Elements use the semantics for those elements as found in: Dublin Core Metadata Element Set <http://purl.org/metadata/dublin_core>.

Label	Use Attribute Value	Element Tag	Semantics
address	3007	(5,64)	Detailed information about a precise location (e.g., name of a street, name of a farm) related to the work
agePeriod	2072	(5,62)	Geologic date associated with specimen
AssociationGeneral	2042	(5,50)	Use for undifferentiated association information related to described object or specimen
award	2000	(5,18)	Prizes or other special recognitions and citations given this object
bibliographicTitle	[bib-1 #4]	(5,33)	Title of the object as defined by bibliographic standards
collection	2002	(5,20)	Information about a group of objects of which this object is a part
condition	2044	(5,52)	Condition of the object, including repairs. The state and integrity of the work
contentGeneral	2030	(5,39)	Undifferentiated content information depicted in or described by object
contextArchaeological	2039	(5,47)	The circumstances in which a work was excavated or discovered
contextHistorical	2038	(5,46)	Political, social, economic or religious events or circumstances associated with the work over time
copyRightRestriction	2004	(5,48)	Any restrictions due to copyright governing the use of this object or of any rendition of it
creatorDateOfBirth	2036	(5,8) dateOfBirth	Date the creator of a work was born (approximate or exact). Put combined birth/death dates in creatorGeneral
creatorDateOfDeath	2037	(5,9) dateOfDeath	Date the creator of the work died (approximate or exact). Put combined birth/death dates in creatorGeneral
creatorGeneral	2041	(5,49)	Undifferentiated creator information. Also put undifferentiated dates (birth & death combined) here
creatorName	2035	(2,7) name	Proper or known names of those responsible for the creation, design, execution, or production of a work
creatorNationalityCultureRace	2009	(5,4) nationalityCulture Race	The national, cultural, or ethnic origins of the person or group of persons responsible for the creation of a work

Label	Use Attribute Value	Element Tag	Semantics
creatorRole	2014	(5,10) role	Part(s) played by the creator(s) in making the work
creditLine	2005	(5,7)	A public statement about the ownership, transfer of ownership, acquisition, source, or sponsorship of the acquisition of a work
dateCollected	2071	(5,61)	Date specimen was collected
dateOfOrigin	2022	(5,45)	Time period, either specific or general, when the object was created
fieldCollector	2070	(5,60)	Name of the person who collected the specimen or conducted the field research
image	2020	[no associated element (s)]	The purpose of this value is to be used in a query to identify all records with associated images. It is not used to search on the digital image. Instead, this Use attribute is used with the Relation attribute 103 (<i>AlwaysMatches</i>) and a term of Null. The schema element associated with this Use attribute is <i>resource</i> .
inscriptionMark	2007	(5,22)	Distinguishing or identifying physical markings, lettering, annotations, texts, or labels that are a part of a work or are affixed, applied, stamped, written, inscribed, or attached to the work, excluding any mark or text inherent in the materials
materialMedium	2008	(5,5)	The substance(s) of which the object is made
objectID	2024	(5,3)	Any unique identifier assigned to an object by its owner or the repository. This ID serves as the unique identification for the object
objectLanguage	2043	(5,51)	The language in which the object is recorded or written
objectName	2032	(5,31)	A categorization, either formal or informal, of an entity. Object names, often known as object types or classification, may be codes referring to a known system, taken from a controlled vocabulary, or freely chosen words assigned to a work
objectTitle	2033	(5,32)	The identifying phrases given to a work by an institution or the creator or common usage which uniquely identifies it
owner	2026	(5,38)	The name of the current owner of the work
periodName	3009	(5,65)	A textual expression of the period when an event in an work's history is thought to have occurred (e.g., Bronze Age, last quarter of 17th century)
physicalDescription	2045	(5,53)	Information pertaining to physical characteristics of the object. General visual appearance of the work, including indication of shape, form, design and color

Label	Use Attribute Value	Element Tag	Semantics
placeOfOrigin	2023	(5,11)	Location, geographic and/or institutional, where a work was created
processTechnique	2012	(5,12)	The means, method, process, or technique by which an object was created
protectionDate	3001	(5,56)	The date at which the protection status was granted
protectionStatus	3000	(5,55)	Indicates whether a work or building is protected, and, if so, the type of protection
provenance	2029	(5,15)	The ownership history of an object including: names and dates of past owners, method of transfer between owners, sales of the work, agents and dealers who handled the work, and information on the disappearance or destruction of the object
relatedTextualReferences	2034	(5,35)	Citations for written works related to or referring to the object, such as books, journals, and exhibition catalogs
repositoryName	2027	(5,1)	The name of the place where a work of art is currently housed. Can include parent institution name
repositoryPlace	2028	(5,26)	The geographic location where the object is currently held
spatialReferencingSystem	3003	(5,57)	A string indicating the spatial referencing system in which search terms for x–coordinate and y–coordinate are expressed.
stylePeriod	2017	(5,14)	The style, historical period, group, school, or movement whose characteristics are represented in the work
subject	2040	(5,2)	Iconography, motif or symbolism. The proper named mythological, fictional, religious, or historical narrative subject matter of a work. Also the meaning or theme represented by the subject matter or iconography
typeSpecimen	2073	(5,63)	Indicates if the specimen is a type specimen. a specimen or specimens (i.e., a fossil or mineral) used in the description of a new kind of fossil organism or a new kind of mineral
who*	2046	<i>[no associated element (s)]</i>	A search using this attribute supports a general inquiry about people, groups of people and institutions. These may have created, owned, stored, been depicted in or had any number of other relationships with the work(s) in question. It can also be data that infers a person, culture or institution, for instance stylePeriod. The data can refer to imaginary beings.

Label	Use Attribute Value	Element Tag	Semantics
what*	2047	[no associated element (s)]	A search using this attribute supports a general inquiry about the work itself. Data that discuss or describe the object, such as its content, place in history or physical nature, is appropriate material for this query.
when*	2048	[no associated element (s)]	A search using this attribute supports a general inquiry about time. Any data that place the work in a time period (such as year, era, season, hour or geologic period) is appropriate for this query.
where*	2049	[no associated element (s)]	A search using this attribute supports a general inquiry about location. This can include place names associated with the work, part of its provenance, or places depicted in it. Locations can be either named or generic, real or imaginary. They can be very specific, as location information might be, or very general.
x-coordinateInReferencingSystem	3004	(5,58)	Along with #3005, a pair of numbers indicating a point in the nominated spatial referencing system; or a pair of ranges indicating an area
y-coordinateInReferencingSystem	3005	(5,59)	Along with #3004, a pair of numbers indicating a point in the nominated spatial referencing system; or a pair of ranges indicating an area

* The "4-W" access points (who, what, when, and where) are provided to enable very coarse-grain searching. The semantics offered are merely for guidance, and servers may implement them as they see fit. Clients should not assume any specific mapping.

The following table provides the semantics for primitive Schema Elements for which there are no associated Use Attributes. These units of information are not intended to serve as access points but may offer helpful information to a user when returned in a retrieval record.

Label	Element Tag	Semantics
dimensions	(5,13)	Size of the object
quantity	(5,17)	Number or amount of items in this object
relatedObjects	(5,16)	Other works connected to the object as part of a collection or a set, suite, ensemble, etc. or a panel that is a part of an altarpiece, etc
resource	(5,30)	The URL or bitstream of this particular rendition of the resource
wallTextLabel	(5,54)	Material in a designated Wall Text or Label database field. This should not be constructed from other fields

The following table provides the semantics for constructed Schema Elements for which there are no associated Use Attributes since searching on these specific units of information in a database record is not anticipated.

Label	Element Tag	Semantics
association	(5,24)	Information about the context of the work. The relationship between a work and a particular environment. Information about the political, social, economic, or religious events or circumstances associated with the work over time
— activity	(5,24)(5,43)	Actions that are associated with the object. As opposed to events, activities tend to be routinely occurring or mundane and usually are not proper named
— description	(5,24)(5,44)	Any descriptive text about the context or associative items that is not covered in other association fields
— event	(5,24)(5,42)	Event or occurrence the object is associated with. Events are either proper named or special occasions, as opposed to mundane activities
— name	(5,24)(2,7)	Names of persons or corporate bodies associated with the object
— place	(5,24)(5,41)	Geographic location or building the object is associated with
content	(5,25)(5,43)	Information about the content of the work
— activity	(5,25)(5,44)	An activity depicted in or described by an object
— description	(5,25)(5,42)	A general description of a depiction in an object, or description of an object without making interpretation
— event	(5,25)(5,40)	An event depicted in or described by an object
— name	(5,25)(2,7)	Names of persons or corporate bodies associated with an object
— place	(5,25)(5,41)	A place depicted in or described by an object
creatorInfo	(5,36)	Indicates that there is creator information
mrObject	(5,28)	Indicates that there is a digital image referenced in the retrieval record
mrObject–title	(5,28)(2,1)	Title of the digital image for this object
mrObject–authorOrCreator	(5,28)(2,2)	Author or creator of the digital image
mrObject–otherContributor	(5,28)(2,32)	Persons who also contributed to the creation of the digital image
mrObject–date	(5,28)(2,8)	Date the digital image was created
mrObject–description	(5,28)(2,17)	Description of the digital image
mrObject–resourceType	(5,28)(2,22)	Type of digital image
mrObject–language	(5,28)(2,20)	The language in which the digital image or metadata is recorded
mrObject–subjectKeyword	(5,28)(2,21)	Any keywords pertaining to the subject matter of the digital image
mrObject–publisher	(5,28)(2,31)	Publisher of digital image
mrObject–format	(5,28)(2,27)	Format of the digital image
mrObject–source	(5,28)(2,33)	Source of the digital image
mrObject–relation	(5,28)(2,30)	Relationship of the digital image to the object
mrObject–coverage	(5,28)(2,34)	Portion of the work depicted or otherwise included in the digital image
mrObject–rights	(5,28)(2,29)	The individual(s) or group that holds any of the rights to use, exhibit, or reproduce the digital image. Include any existing restrictions on its reproduction, or use
mrObject–rendition	(5,28)(5,29)	Indicates that there is a particular rendition of this instance of <i>mrObject</i>
rendition–resource	(5,29)(5,30)	The URL or bitstream of this particular rendition of the digital image
rendition–title	(5,29)(2,1)	Title of this particular rendition of the digital image; often same as the <i>mrObject–title</i>
rendition–authorOrCreator	(5,29)(2,2)	Person, institution, corporation, or group primarily responsible for the creation of this rendition
rendition–otherContributor	(5,29)(2,32)	Person, institution, corporation, or group secondarily responsible for the creation of this rendition
rendition–date	(5,29)(2,8)	Date rendition was created

Label	Element Tag	Semantics
rendition-description	(5,29)(2,17)	Description of the rendition
rendition-resourceType	(5,29)(2,22)	Type of digital image this rendition is
rendition-resourceIdentifier	(5,29)(2,28)	ID for this rendition
rendition-language	(5,29)(2,20)	The language in which the data is recorded in this rendition
rendition-subjectKeyword	(5,29)(2,21)	Keywords pertaining to the subject matter in this rendition
rendition-publisher	(5,29)(2,31)	Publisher of this rendition
rendition-format	(5,29)(2,27)	Format of this rendition
rendition-source	(5,29)(2,33)	Source of the rendition
rendition-relation	(5,29)(2,30)	Relationship of the rendition to the digital image
rendition-coverage	(5,29)(2,34)	Which part(s) of the digital image does this rendition include
rendition-rights	(5,29)(2,29)	The individual(s) or group that holds any of the rights to use, exhibit, or reproduce this rendition of the digital image. Include any existing restrictions on its reproduction, or use

APPENDIX D

Dublin Core Mapping to USMARC

The Library of Congress Network Development and MARC Standards Office created to following document to provide a mapping between Dublin Core Metadata Elements and USMARC. The original document included a crosswalk to GILS data elements, but these have been removed for purposes of the CIMI Profile. The full document is available as Dublin Core/MARC/GILS Crosswalk (last updated: 04/07/97) <<http://lcweb.loc.gov/marc/dccross.html>>.

Introduction

The following is a crosswalk between the fifteen elements in the Dublin Core Element Set <http://purl.oclc.org/metadata/dublin_core> on the one hand and both MARC bibliographic data elements. The crosswalk may be used in conversion of metadata from some other syntax into MARC. For conversion of MARC into Dublin Core, many fields would be mapped into a single Dublin Core element; this is not entirely covered in this document.

In the Dublin Core to MARC mapping, in some cases there are two mappings provided. The first is a simple mapping and is used if the Dublin Core elements are used without qualifiers. The second is for a more complex description for which the elements have qualifiers. There could be a mixture, but if the particular element is unqualified, then the simple mapping for that element should be used. Certain defaults have been assumed as to definitions and qualifiers; if this changes the list will need to be adjusted. Where applicable, subfields are given.

USMARC fields are listed with field number, then in parentheses field name/subfield name (if both are the same, no subfield name is included). If the value of the indicator is not provided, use a blank (H'20'). The label is a shortened form of the element name. GILS attribute names for each Dublin Core element are also given. Definitions are taken from Dublin Core Metadata Element Set: Reference Description <http://purl.oclc.org/metadata/dublin_core_elements>.

Dublin Core to MARC and GILS Crosswalk.

Title

The name given to the resource by the CREATOR or PUBLISHER.

USMARC:

- 245\$a (Title Statement/Title proper) (1st indicator=0)
- If repeated, all titles after the first: 246\$a (Varying Form of Title/Title proper)

Author or Creator

The person(s) or organization(s) primarily responsible for the intellectual content of the resource. For example, authors in the case of written documents, artists, photographers, or illustrators in the case of visual resources. Qualifier possible: type.

USMARC:

- 720\$a (Added Entry—Uncontrolled Name/Name) (with \$e=author)
- If type=personal: 700\$a (Added entry—Personal Name)
- If type=corporate: 710\$a (Added entry—Corporate Name)

Subject and Keywords

The topic of the resource, or keywords or phrases that describe the subject or content of the resource. The intent of the specification of this element is to promote the use of controlled vocabularies and keywords. This element might well include scheme-qualified classification data (for example, Library of Congress Classification Numbers or Dewey Decimal numbers) or scheme-qualified controlled vocabularies (such as MEDical Subject Headings or Art and Architecture Thesaurus descriptors) as well. Qualifier possible: scheme.

USMARC:

- 653\$a (Index Term—Uncontrolled)
- If scheme=LCSH: 650\$a (Subject added entry—topical term)
- If scheme=LCC: 050\$a (Library of Congress Call Number/Classification number)
- If scheme=DDC: 082\$a (Dewey Decimal Call Number/Classification number)
- If scheme=(other): 650\$a (with \$2=code from USMARC Code List for Relators, Sources, Description Conventions)

Description

A textual description of the content of the resource, including abstracts in the case of document-like objects or content descriptions in the case of visual resources. Future metadata collections might well include computational content description (spectral analysis of a visual resource, for example) that may not be embeddable in current network systems. In such a case this field might contain a link to such a description rather than the description itself.

USMARC:

- 520\$a (Summary, etc. note)

Publisher

The entity responsible for making the resource available in its present form, such as a publisher, a university department, or a corporate entity. The intent of specifying this field is to identify the entity that provides access to the resource.

USMARC:

- 260\$b (Publication, Distribution, etc. (Imprint)/Name of publisher, distributor, etc.)

Other Contributors

Person(s) or organization(s) in addition to those specified in the CREATOR element who have made significant intellectual contributions to the resource but whose contribution is secondary to the individuals or entities specified in the CREATOR element (for example, editors, transcribers, illustrators, and convenors). Qualifier possible: type.

USMARC:

- 720\$a (Added Entry—Uncontrolled Name/Name) \$e [content of role qualifier]
- If type=personal: 700\$a (Added Entry—Personal Name)
- If type=corporate: 710\$a (Added Entry—Corporate Name)

Date

The date the resource was made available in its present form. The recommended best practice is an 8 digit number in the form YYYYMMDD as defined by ANSI X3.30-1985. In this scheme, the date element for the day this is written would be 19961203, or December 3, 1996. Many other schema are possible, but if used, they should be identified in an unambiguous manner. Qualifier possible: type

USMARC:

- 260\$c (Date of publication, distribution, etc.)
- If type=modified: 005 (Date and time of latest transaction)
- If scheme=ANSI X3.30 or ISO 8601, date may also be generated in 008/07-10; see below under Notes.

Resource Type

The category of the resource, such as home page, novel, poem, working paper, technical report, essay, dictionary. It is expected that RESOURCE TYPE will be chosen from an enumerated list of types. A preliminary set of such types can be found at the following URL:

<http://www.roads.lut.ac.uk/Metadata/DC-ObjectTypes.html>.

USMARC:

- 655\$a (Index Term—Genre/Form) (with \$2=local)

Format

The data representation of the resource, such as text/html, ASCII, Postscript file, executable application, or JPEG image. The intent of specifying this element is to provide information necessary to allow people or machines to make decisions about the usability of the encoded data (what hardware and software might be required to display or execute it, for example). As with RESOURCE TYPE, FORMAT will be assigned from enumerated lists such as registered Internet Media Types (MIME types). In principal, formats can include physical media such as books, serials, or other non-electronic media.

USMARC:

- 856\$q (Electronic Location and Access/File transfer mode)

Resource Identifier

String or number used to uniquely identify the resource. Examples for networked resources include URLs and URNs (when implemented). Other globally-unique identifiers, such as International Standard Book Numbers (ISBN) or other formal names would also be candidates for this element. Qualifier possible: scheme.

USMARC:

- 856\$u (Uniform Resource Locator)
- If type is IP address: 856\$b (Access number)
- If scheme=ISBN: 020\$a (International Standard Book Number)
- If scheme=ISSN: 022\$a (International Standard Serial Number)
- If scheme=URN: 856\$u with initial "urn:" (with 1st indicator=7)
- If scheme=(other): 024\$a (with 1st indicator=8)(Other Standard Identifier/Standard number or code)

Source

The work, either print or electronic, from which this resource is derived, if applicable. For example, an html encoding of a Shakespearean sonnet might identify the paper version of the sonnet from which the electronic version was transcribed.

USMARC:

- 786\$n (Data Source Entry/Title) (with 1st indicator=0)

Language

Language of the intellectual content of the resource. Where practical, the content of this field should coincide with the Z39.53 three character codes for written languages. Qualifier possible: scheme.

USMARC:

- 546\$a (Language note)
- If scheme=Z39.53: 041\$a (Language code)
- If scheme=USMARC: 041\$a (Language code)
- If scheme=Z39.53, Language may also be generated in 008/35–37; see below under Notes.

Relation

Relationship to other resources. The intent of specifying this element is to provide a means to express relationships among resources that have formal relationships to others, but exist as discrete resources themselves. For example, images in a document, chapters in a book, or items in a collection. A formal specification of RELATION is currently under development. Users and developers should understand that use of this element should be currently considered experimental. Possible qualifiers: scheme, type.

USMARC:

- 787\$n (Nonspecific Relationship Entry/Note) (1st indicator=0)
- If scheme=URL: 787\$o (Nonspecific Relationship Entry/Note—Other identifier)

Coverage

The spatial locations and temporal durations characteristic of the resource. Formal specification of COVERAGE is currently under development. Users and developers should understand that use of this element should be currently considered experimental. Possible qualifier: type.

USMARC:

- 500\$a (General note)
- If type=spatial: 255\$c (Cartographic Mathematical Data/Statement of coordinates)
- If type=temporal: 513\$b (Type of Report and Period Covered Note/Period covered)

Rights Management

The content of this element is intended to be a link (a URL or other suitable URI as appropriate) to a copyright notice, a rights-management statement, or perhaps a server that would provide such information in a dynamic way. The intent of specifying this field is to allow providers a means to associate terms and conditions or copyright statements with a resource or collection of resources. No assumptions should be made by users if such a field is empty or not present. Qualifiers possible: URL, URN.

USMARC:

- 540\$a (Terms Governing Use and Reproduction Note)
- If scheme=URL: 856\$u (with \$3=rights)

Notes:

In addition to the variable length fields listed in the mapping, a USMARC record will also include a Leader and field 008 (Fixed-Length Data Elements). Certain character positions in each of these fixed length fields of a USMARC record will need to be coded, although most will generate default values.

Leader: a fixed field comprising the first 24 character positions (00–23) of each record that provides information for the processing of the record. The following positions should be generated:

- Character Position 06: Type of record
 - If resource is an electronic information resource, use code "m"
 - If resource is geospatial, use code "e"
 - All others use code "a"
- Character Position 18: Descriptive cataloging form
 - Use value # (blank) (Non-ISBD) to indicate that International Standard Bibliographic Description is not followed.

008 Fixed Length Data Elements: Forty character positions (00–39) containing positionally–defined data elements that provide coded information about the record as a whole or about special bibliographic aspects of the item being cataloged. For records originating as Dublin Core, the following character positions are used:

- Character positions 00–05: Date the USMARC record was created or converted (from Date element with scheme=ANSI X3.30 or ISO 8601 and qualifier type=modified or may be generated; formatted as YYMMDD)
- Character positions 07–10: Date of Publication (YYYY portion from Date if present)
- Character positions 35–37: Language. May be generated from data in Language if scheme=Z39.53.
- Other character positions can default to fill characters (ASCII 7C)

042\$a Authentication Code

Value: dc (new code to identify USMARC records derived from Dublin Core style record).

Uses for mapping Dublin Core to MARC

A mapping between the elements in the Dublin Core and USMARC fields is necessary so that conversions between various syntaxes can occur accurately. Once Dublin Core style metadata is widely provided, it might interact with MARC records in various ways such as the following:

Enhancement of simple resource description record. A cataloging agency may wish to extract the metadata provided in Dublin Core style (presumably in HTML or SGML) and convert the data elements to MARC fields, resulting in a skeletal record. That record might then be enhanced as needed to add additional information generally provided in the particular catalog.

Searching across syntaxes and databases. Libraries have large systems with valuable information in MARC bibliographic records (which may also be called metadata). Over the past few years with the expansion of electronic resource over the Internet, other syntaxes have also been considered for providing metadata. The Library of Congress has worked with a group of SGML experts to create a Document–Type Definition (DTD) for MARC, so that conversions can be made between SGML and MARC in a standardized way. It will be important for systems to be able to search metadata in different syntaxes and databases and have commonality in the definition and use of elements.

Members of the CIMI Z39.50 Working Group 1995–1998

The CIMI Z39.50 Working Group evolved during the development of the CIMI Profile. The list below identifies all people who participated at two or more meetings of the Z39.50 Working Group from its initial meeting in September 1995 through the completion of the CIMI Z39.50 Interoperability Testbed in January 1998. Some members were involved in various stages of the profiling work and others were participants throughout the entire period. This list is based upon attendance records at the meetings.

Names identified in **bold** were participants in the CIMI Z39.50 Interoperability Testbed. Others served in varying capacities in the development of the draft CIMI Profile (June 1996) and subsequent profiling effort.

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The CIMI Z39.50 Interoperability Testbed: Distributed Searching of Museum and Bibliographic Information

In Spring 1997, the Consortium for the Computer Interchange of Museum Information (CIMI) <<http://www.cimi.org>> issued a call for participation in the CIMI Z39.50 Interoperability Testbed. The testbed is the final phase of a two-year (1995–1997) demonstration project funded by the National Endowment for the Humanities. This project involved numerous museum, systems, and Z39.50 experts who examined, explored, and specified the use of ANSI/NISO Z39.50, the information retrieval protocol standard, in distributed search and retrieval of cultural heritage information. The ultimate goal of this two-year experience was to produce an application profile that details Z39.50 specifications for use by museums and other cultural heritage information centers.

CIMI consists of 16 member organizations working cooperatively to solve problems that restrict the electronic interchange of museum information. The interchange of information among different systems and organizations requires the use of standards, which is why Z39.50 is such an important part of the effort to disseminate cultural heritage information.

Z39.50 is a mature standard. It represents the result of nearly two decades of implementation experience and debate within libraries and museums about how information retrieval can be carried out in a distributed environment in which people in different places using different systems can exchange information at a deep and meaningful level. As museums and libraries throughout the world adopt this standard, cultural heritage information, including text, audio, and video—now held in "islands of information," will become uniformly available to anyone who has access to a computer terminal.

The development of the CIMI Profile began in September 1995 with the establishment of a working group responsible for developing and detailing the Z39.50 specifications to support the search and retrieval of museum information. The working group comprised Z39.50 experts, information systems experts, and experts in museum systems and museum information resources. CIMI issued a draft Profile <<http://lcweb.loc.gov/z3950/agency/profiles/cimi2.html>> in Summer 1996 for review and comment by the broader museum and cultural heritage information community. In Fall 1996 and Winter 1997, the working group discussed strategies for testing the draft Profile through an interoperability testbed.

The call for participation in the testbed resulted in 42 responses from a wide spectrum of museums, libraries, system vendors, software developers, universities, and research centers. The strong response to CIMI's call for participation confirmed the pressing need for CIMI's work on standards and interoperability to enable information interchange and sharing regardless of the systems used to store or retrieve the information. CIMI chose 5 participants and 2 alternatives to participate in the testbed; those participants included the largest museum collections management vendor in North America, from several groups involved in enormous cultural databanks throughout Europe, and from a vitally important national museum project in Taiwan. Several CIMI members are also participating in the testbed. CIMI also entered into sponsoring

relationships with two software developers to build Z39.50 tools (server and clients) for use in the testbed (see table on verso).

The testbed participants began working in late Spring with a draft CIMI Interoperability Testbed Implementors Agreement <<http://www.cimi.org/documents/iaaug29e.html>>, which was a subset of specifications from the draft CIMI Profile. The purpose of the Implementors Agreement was to provide the necessary specifications for the participants to build Z39.50 implementations for the testbed.

The primary goal of the testbed was to demonstrate how Z39.50 can support search and retrieval of specific types of museum information resources (i.e., collection management object records, images with associated text, bibliographic records) and other resource as available between multiple server and client implementations. Interoperability testing between installed Z39.50 bibliographic clients and servers was desirable. In the past four months, testbed participants made rapid progress in their implementations, and the testbed culminates in October 1997 with interoperability demonstrations at the Museum Computer Network Conference in St. Louis. The implementation experience of the testbed provides the basis for revising the draft CIMI Profile, which will be completed by the end of 1997.

In addition to the experience gained by the implementors, the testbed resulted in the following products:

- CIMI Java Z39.50 Client (Blue Angel Technologies)
- CIMI Z39.50 Server Toolkit (System Simulation Ltd.)
- Revised CIMI Profile
- Z39.50 servers & clients that support CIMI specifications.

For Additional Information

If you are interested in participating in CIMI or in information on CIMI's current projects related to standards and interoperability, visit the CIMI website: <www.cimi.org> or contact: **John Perkins**, CIMI executive director at <jperkins@fox.nstn.ns.ca> or 902-826-2824.

For additional information on the CIMI Interoperability Testbed, contact: **William E. Moen**, CIMI Z39.50 Project Manager, <wemoen@jove.acs.unt.edu> tel: 940-565-3563

This Project is supported by a generous grant from the National Endowment for the Humanities, an independent U.S. Federal agency.

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