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The OpenURL Framework for Context-Sensitive Services

Abstract: The OpenURL Framework Standard defines an architecture for creating OpenURL Framework Applications. An OpenURL Framework Application is a networked service environment, in which packages of information are transported over a network. These packages have a description of a referenced resource at their core, and they are transported with the intent of obtaining context-sensitive services pertaining to the referenced resource. To enable the recipients of these packages to deliver such context-sensitive services, each package describes the referenced resource itself, the network context in which the resource is referenced, and the context in which the service request takes place.

This Standard specifies how to construct these packages as Representations of abstract information constructs called ContextObjects. To this end, the OpenURL Framework Standard defines the following core components: Character Encoding, Serialization, Constraint Language, ContextObject Format, Metadata Format, and Namespace. In addition, this Standard defines Transport, a core component that enables communities to specify how to transport ContextObject Representations. Finally, this Standard specifies how a community can deploy a new OpenURL Framework Application by defining a new Community Profile, the last core component.

This Standard defines the OpenURL Framework Registry and the rules that govern the usage of this Registry. The OpenURL Framework Registry contains all instances of all core components created by communities that have deployed OpenURL Framework Applications. This Standard defines and registers the initial content of the OpenURL Framework Registry, thereby deploying two distinct OpenURL Framework Applications.

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Foreword

(This foreword is not part of *The OpenURL Framework for Context Sensitive Services*, ANSI/NISO Z39.88-2004. It is included for information only.)

History

As the World Wide Web began its explosive growth in the early 1990s, the scholarly-information community made available digital scholarly materials, consisting of metadata and full-text content. As this body of materials grew, it became increasingly difficult to provide adequate links between related information assets, distributed across many collections and controlled by different custodians. By 1999, the scholarly-information community had embarked on several linking efforts, surveyed in Van de Sompel and Hochstenbach [R1].

In 1999, NISO started a series of invitational workshops to explore issues in the area of reference linking. Representatives from the library, publishing, and information services communities identified the appropriate-copy problem as a major issue, because its solution was expected to solve other link-resolution problems. The appropriate-copy problem arises when multiple copies of a resource exist, and each copy is governed by a different access policy. A specific user should be directed to a copy of the resource that is governed by an access policy compatible with that user's access privileges. None of the proposed linking architectures could accomplish this.

A series of collaborations by Herbert Van de Sompel (Ghent University, Los Alamos National Laboratory, and Cornell University), Patrick Hochstenbach (Ghent University), and Oren Beit-Arie (Ex Libris) culminated in the solution of the appropriate-copy problem. Their solution also addressed related issues in the delivery of context-sensitive services for the web-based scholarly information environment. This collaboration resulted in:

- Development of the SFX linking server and the OpenURL architecture [R1] [R2] [R3].
- Publication of the OpenURL 0.1 specification that defines an HTTP GET syntax for transporting metadata and identifiers from an information service to a linking server. The transported metadata and identifiers describe a referenced item and some contextual information [R4].
- Publication of the OpenURL Framework, which provides a design for context-sensitive reference linking in the Web-based scholarly information environment [R5].

The scholarly-information community quickly embraced the OpenURL 0.1 specification. Publishers, vendors of abstracting and indexing databases, preprint systems, and CrossRef (a Registration Agency for Digital Object Identifiers or DOIs) introduced OpenURLs in their systems. Many libraries implemented OpenURL-conformant linking servers that provide their users with context-sensitive links. This quick adoption by so many constituents established OpenURL 0.1 as a de-facto standard.

In preparation for the NISO Standardization effort, Herbert Van de Sompel and Oren Beit-Arie studied OpenURLs in real environments and analyzed the information sent to OpenURL resolvers. Based on this analysis, they proposed the Bison-Futé model [R6], a generalization of OpenURL 0.1 based on the notion of a ContextObject. A ContextObject is an information construct that formalizes and generalizes the information packaged in OpenURL 0.1 requests:

OpenURL 0.1	ContextObject
The OpenURL 0.1 specification explicitly includes the referenced resource, the system that provides the OpenURL (sid), and the linking server that is the target of the OpenURL.	The ContextObject definition formalizes these resources into, respectively, the Referent, the Referrer, and the Resolver Entities.
OpenURL 0.1 usage showed that three more resources were regularly described in the Private Identifier (pid): the initiator of an OpenURL transport (the user clicking the OpenURL), the citing scholarly work, and the type of service requested (for example, “provide full-text”).	The ContextObject definition formalizes these resources into, respectively, the Requester, the ReferringEntity, and the ServiceType Entities.
OpenURL 0.1 specifies one set of metadata keys to describe a referenced scholarly work by inline metadata.	The ContextObject definition generalizes this description method into the By-Value Metadata Descriptor of Entities. This Descriptor depends on Metadata Formats that are made available through registration in the OpenURL Framework Registry.
OpenURL 0.1 specifies namespaces for identifiers of referenced scholarly works, for the system that provides the OpenURL, and for the target of the OpenURL.	The ContextObject definition generalizes this description method into the Identifier Descriptor of Entities. This Descriptor depends on Namespaces for Identifiers that are made available through registration in the OpenURL Framework Registry.
OpenURL 0.1 allows for private data to describe a referenced scholarly work by a method that is specific to the provider of the OpenURL. To process this syntax, a linking server must enter into some prior agreement with the provider of the OpenURL.	The ContextObject definition generalizes this description method into the Private Data Descriptor of Entities.
OpenURL 0.1 usage showed that the Private Identifier (pid) of OpenURL 0.1 often contains a pointer to metadata describing the referenced scholarly work.	The ContextObject definition generalizes this description method into the By-Reference Metadata Descriptor of Entities. This Descriptor depends on Metadata Formats that are made available through registration in the OpenURL Framework Registry.

In 2001, NISO formed Committee AX to prepare this Standard. The Committee’s charge [R7] was to develop an extensible mechanism for the representation and transportation of packages of metadata and identifiers that are useful in the delivery of context-sensitive services. The table above shows how the OpenURL 0.1 specification inspired the ContextObject concept of the Bison-Futé model. The Committee took this concept as the starting point for its work. To achieve extensibility, the Committee embedded the ContextObject concept in a general (and abstract) framework, called the OpenURL Framework.

This framework is defined in Part 1 and consists of the following core components: Namespaces for Identifiers, Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats, Transports, and Community Profiles. To create an instantiation of the OpenURL

Framework for a particular application domain, a community must specify and register specific selections of these core components in the OpenURL Framework Registry.

Although it retains the name OpenURL in its title for historical reasons, the OpenURL Framework is neutral with respect to application domain. The Committee hopes that the ContextObject specified in this Standard will become a generic component for systems providing contextual services pertaining to resources that are referenced on networks.

References

[R1] Van de Sompel H, Hochstenbach P. *Reference Linking in a Hybrid Library Environment, Part 1: Frameworks for Linking*. D-Lib Magazine, 1999. 5(4). doi:10.1045/april99-van_de_sompel-pt1 [online] [cited 4 November 2004] Available from World Wide Web: <http://www.dlib.org/dlib/april99/van_de_sompel/04van_de_sompel-pt1.html>

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[R6] Van de Sompel H, Beit-Arie O. *Generalizing the OpenURL Framework beyond References to Scholarly Works: the Bison-Futé model*. D-Lib Magazine, 2001. 7(7/8). doi:10.1045/july2001-vandesompel [online] [cited 4 November 2004] Available from World Wide Web: <http://www.dlib.org/dlib/july01/vandesompel/07vandesompel.html>

[R7] National Information Standards Organization. *The OpenURL Framework for Context-Sensitive Services. Standards Committee AX. Charge.* [online] [cited 4 November 2004] Available from World Wide Web: <http://www.niso.org/committees/committee_ax.html>

Preamble

Wide adoption of any technology or process is often a result of its simplicity coupled with the effective meeting of a market need. OpenURL has been embraced and adopted by the scholarly-information community for these very reasons.

The early implementation of OpenURL was simple in concept: it used HTTP GET or POST to transfer information about an item (a journal article, for example) from an online service to a linking server. The specifications were simple. They described the protocol, the syntax, and how a referenced item is to be represented by using particular sets of data element names on a URL. This is best demonstrated by an example of an OpenURL:

```
http://www.example.com/resolver?genre=article
&atitle=p27-p16 Chimera: A Superior Antiproliferative
&title=Molecular Theory
&aulast=McArthur
&aufirst=James
&date=2001
&volume=3
&issue=1
&spage=8
&epage=13
```

Because of this simplicity, developers working for online service providers and developers of linking servers could quickly understand how OpenURL worked and develop their own products. The scholarly-information community responded by quickly adopting link resolvers as a basic component of its digital library infrastructure.

The Committee recognized the status of this early version of OpenURL as a de facto standard. The *OpenURL Framework Standard* (Z39.88-2004) refers to the early version as OpenURL 0.1, and the OpenURL 0.1 specifications are retained in the OpenURL Framework Registry <http://www.openurl.info/registry/docs/pdf/openurl-01.pdf>.

The simplicity of OpenURL 0.1 is due, in part, to the static nature of its syntax, the limited number of genres supported, the fixed sets of data elements, and the fixed transport protocol (HTTP). However, the fixed nature of OpenURL 0.1 not only limits its expansion within the scholarly-information community, it also prevents other communities from adopting OpenURL for similar needs. For example, OpenURL 0.1 cannot be extended to cover other genres of materials. It cannot even extend the data element sets for existing genres. The *OpenURL Framework Standard* is about providing such extensibility.

In developing this Standard, the Committee wanted to provide the needed extensibility while retaining the simplicity of the original OpenURL. To accomplish this, the fundamentals of an extensible framework had to be put in place. This document describes these fundamentals: the framework upon which OpenURL can be extended with new genres, new data elements, different character encodings (to support non-English use of the OpenURL), various network protocols, and data representations.

Part 1 (Sections 5 through 11) describes the ContextObject. The ContextObject is the information construct that describes an item that is the subject of a service request and the context within which the request is being made. While the term ContextObject may be new, the concept it represents is entirely compatible with OpenURL 0.1. Indeed, the original OpenURLs were precisely about a request to provide a service (for example, asking a link server to provide a menu of relevant links) expressed in an HTTP link, whereby the HTTP link described an item and provided some context within which it was referenced. Part 1 formalizes the expression of the item description, its context, and the service being requested. The definitions of all concepts are separated from their representation and the protocol by which the representations are transported.

Very few bounds are placed on how ContextObjects can be extended or applied. The Committee did not want to prescribe the limits on what kinds of creative applications there might be for ContextObjects and the OpenURL Framework in other communities. For example, the Committee could imagine storing ContextObjects in databases or using ContextObjects as the containers to transfer item and context information between servers in a web services environment. Two linking servers could talk to one another by exchanging ContextObjects. In the latter scenario, ContextObjects might be transported using an XML-based protocol such as SOAP. OpenURL 0.1 did not provide such capabilities.

Such abstraction and open-endedness is sometimes disconcerting for the development community. System providers may be reluctant to invest development resources if they fear that the Standard is too general to be able to create interoperable solutions or that the Standard may change without their knowledge or involvement. To address these issues, the Committee introduced the notions of the OpenURL Framework Registry, OpenURL Framework Application, and Community Profile.

The OpenURL Framework Registry <http://www.openurl.info/registry> provides a mechanism for the public disclosure of specific selections for the representation and transportation of ContextObjects. For the purpose of this discussion, these selections will be described as registered entries. Each registered entry is assigned a unique identifier so it may be referenced unambiguously.

An OpenURL Framework Application is one instantiation of the OpenURL Framework meant for a specific community of adopters in a particular application domain. In essence, Part 1 specifies how a community can define their own OpenURL Framework Application. In general terms, a community defines an OpenURL Framework Application by selecting entries from the Registry it needs to represent and transport ContextObjects. If necessary and/or desired, the community may define new entries and, subject approval of Registry administrators, register these new entries.

A Community Profile is an unambiguous summary of one OpenURL Framework Application. For an implementer, the Community Profile unambiguously specifies the scope and boundaries of compliance by listing a selection of registered entries that OpenURL Framework Applications within that community are expected to support. To prevent a given Community Profile from becoming a moving target for a developer, the Committee envisions the Registry being under strict version control. When a community chooses to evolve its OpenURL Framework Application, it develops a new Community Profile. It may have to create new entries, register them, and have new unique identifiers assigned to them.

Part 2 (Sections 12 through 15) defines a ContextObject Format inspired by the query string of the HTTP(S) GET request as specified in OpenURL 0.1. The Key/Encoded-Value or KEV ContextObject Format defines how to represent a ContextObject as a concatenation of ampersand-delimited Key/Encoded-Value pairs. The foremost purpose of the KEV ContextObject Format is backward compatibility. It provides an elegant transition from the OpenURL 0.1 specification to this Standard.

Part 3 (Sections 16 through 19) defines a ContextObject Format based on XML (eXtensible Markup Language). XML Documents are widely used in the exchange of structured text and data between computer applications. The XML ContextObject Format is about the future. Using the full expressive power of the XML syntax, ContextObjects can convey greater detail, which Resolvers can use to provide more appropriate services.

Part 4 (Sections 20 through 22) specifies mechanisms by which ContextObject Representations can be transported using the HTTP(S) protocol. Collectively, these are called OpenURL Transports.

Parts 2, 3, and 4 define the initial content of the OpenURL Framework Registry, which is sufficient to deploy two OpenURL Framework Applications. These two Applications are defined by two Community Profiles: the Level 1 San Antonio Community Profile (SAP1) and the Level 2 San Antonio Community Profile (SAP2). They are defined, respectively, in Appendix C and Appendix D.

SAP1 formalizes the OpenURL 0.1 specification under the new Standard and adds a few of the enhancements requested by the scholarly-information community. To further assist developers in transitioning their existing application to one that complies with SAP1, a set of Implementation Guidelines have been created to provide step-by-step instructions <http://www.openurl.info/registry/docs/implementation_guidelines>.

To illustrate how SAP1 retains the original simplicity of OpenURL 0.1, let us convert the OpenURL 0.1 sample given earlier to an OpenURL that conforms with the OpenURL Framework Application defined by SAP1:

```
http://www.example.com/resolver?url_ver=Z39.88-2004
&url_ctx_fmt=info:ofi/fmt:kev:mtx:ctx
&rft_val_fmt=info:ofi/fmt:kev:mtx:journal
```

```
&rft.genre=article
&rft.atitle=p27-p16 Chimera: A Superior Antiproliferative
&rft.jtitle=Molecular Theory
&rft.aulast=McArthur
&rft.aufirst=James
&rft.date=2001
&rft.volume=3
&rft.issue=1
&rft.spage=8
&rft.epage=13
```

Three new tags have been added for version control and format declaration (to describe to the linking server what follows), and prefixes have been added to the tags to avoid ambiguity.

With tools like the Implementation Guidelines, the San Antonio Profiles, and the OpenURL Framework Registry, the OpenURL Framework Standard extends the ideas underlying the original OpenURL to new and creative uses, while it retains the simplicity of its predecessor.

Technical Considerations

Recognizing the international environments in which ContextObjects will be used, the Committee selected Unicode as the abstract character repertoire for ContextObjects. Without excluding other encoding forms, the Committee selected UTF-8 as the default encoding form of the Unicode Coded Character Set.

This Standard originated in the scholarly-information community for the purpose of providing context-sensitive linking services. The significantly more general OpenURL Framework is a reflection of NISO's charge to the Committee to develop an extensible Standard. Extensibility is implemented through the OpenURL Framework Registry. Initially, this Registry contains entries that support the creation of OpenURL Framework Applications in the scholarly-information community. However, other user communities may add new entries to support different applications. The Registry records the following:

- To support the representation of ContextObjects and the resources of which ContextObjects convey descriptions:
  - Character Encodings
  - Formats to express ContextObjects, including the Serializations, Constraint Languages, and Constraint Definitions used by those Formats. For example, the XML ContextObject Format uses XML as its Serialization and is constrained by an XML Schema.
  - Namespaces used to identify resources of which ContextObjects contain descriptions
  - Metadata Formats used to represent particular classes of resources of which ContextObjects contain descriptions
- Methods to transport ContextObject Representations
- Community Profiles that list selections of the above made by specific communities for their OpenURL Framework Application

The initial Registry contains two Formats to express ContextObjects: the Key/Encoded-Value Format and the XML Format. Communities may define and register new ContextObject Formats, thereby enabling the creation of new OpenURL Framework Applications. The initial Registry also contains a suite of HTTP(S)-based methods to transport representations of ContextObjects. Two Community Profiles are included in the initial content of the Registry. The Committee created these to provide support for the existing OpenURL 0.1 application as used in the scholarly-information community under this Standard.

The Level 1 San Antonio Community Profile (SAP1): A Community Profile that is based on the Key/Encoded-Value Format to represent ContextObjects. It uses Namespaces and Metadata Formats that are important to the scholarly-information community. In the definition of this Community Profile, care has been taken to provide a certain level of backward compatibility with the OpenURL 0.1 specification, while at the same time providing enhanced capabilities to describe referenced resources and the network context in which the references occur.

The Level 2 San Antonio Community Profile (SAP2): A Community Profile that is based on the XML Format to represent ContextObjects. It uses Namespaces and Metadata Formats that are important to the scholarly-information community. It introduces a new level of expressiveness to describe referenced resources and the network context in which the references occur.

Trademarks, Service Marks

Wherever used in this Standard, all terms that are trademarks or service marks are and remain the property of their respective owners.

This Standard was processed and approved for submittal to ANSI by the National Information Standards Organization. It was balloted by the NISO Voting Members January 26, 2004-March 10, 2004. This Standard will be up for review in 2009. Suggestions for improving this Standard are welcome. They should be sent to the National Information Standards Organization, 4733 Bethesda Avenue, Suite 300, Bethesda, MD 20814. NISO approval of this Standard does not imply that all Voting Members voted for its approval.

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The following individuals served on Committee AX, *The OpenURL Framework for Context-Sensitive Services*:

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The OpenURL Framework for Context-Sensitive Services

1 Purpose and Scope

The OpenURL Framework Standard defines an architecture for creating OpenURL Framework Applications, briefly called *Applications* in the remainder of this Standard. An *Application* is a networked service environment, in which packages of information are transported over a network. These packages have a description of a referenced resource at their core, and they are transported with the intent of obtaining context-sensitive services pertaining to the referenced resource. To enable the recipients of these packages to deliver such context-sensitive services, each package describes the referenced resource itself, the network context in which the resource is referenced, and the context in which the service request takes place. These packages are *ContextObject Representations.*

Part 1 (Sections 5 through 11) defines the *ContextObject* as an abstract information construct. This Standard is independent of the application domain. It does not constrain the type of resources that may be described in a *ContextObject.* However, it does specify how communities can create concrete *ContextObject Representations* for use in their *Applications.* To that end, this Standard introduces the following core components of the OpenURL Framework: *Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats,* and *Namespaces.*

Although *ContextObject Representations* ***may*** reside as autonomous data files in information systems, this Standard expects that *ContextObject Representations* will be transported between networked systems. Section 10 defines *Transports,* a core component of the OpenURL Framework in which communities specify how to transport *ContextObject Representations* in their *Applications.* This Standard does not restrict the purpose of such transportation. It is expected, however, that most transportations of *ContextObject Representations* will be requests for context-sensitive services pertaining to the referenced resource.

The targets of the transportation of *ContextObject Representations* are networked systems that are able to process *ContextObject Representations* and provide context-sensitive services. These systems are called *Resolvers. Resolver* behavior and usage are outside of the scope of this Standard. However, a community ***may*** use a *Community Profile* to define conformance for *Resolvers* that operate in its application domain. A community specifies its selections for each of the aforementioned core components in a *Community Profile.* This is the final core component of the OpenURL Framework, and it is defined in Section 11.

Section 6 defines the *OpenURL Framework Registry* and the rules that govern its usage. The *OpenURL Framework Registry* contains the selections for all core components made by communities that define *Applications.* The *Registry* ensures that this Standard can be used in many different application domains.

Parts 2, 3, and 4 specify the initial content of the *OpenURL Framework Registry* and provide detailed definitions of the registered content. The initial *Registry* deploys two *Applications* for the scholarly-information community. These *Applications* are defined by two *Community Profiles:*

- The Level 1 San Antonio Community Profile (SAP1), defined in Appendix C, is based on a Key/Encoded-Value *Representation* of *ContextObjects. Key/Encoded-Value ContextObject Representations* may be transported by any one of the three HTTP-based *Transports* defined in Part 4. The *Transport* defined in Section 22 was developed to provide a certain level of backward compatibility with the OpenURL 0.1 specification.

- The Level 2 San Antonio Community Profile (SAP2), defined in Appendix D, is based on an XML *Representation* of *ContextObjects. XML ContextObject Representations* may be transported by any one of two HTTP-based Transports defined in Part 4, Sections 20 and 21. The SAP2 *Community Profile* is not backward compatible with the OpenURL 0.1 specification.

Part 2 (Sections 12 through 15) defines a *ContextObject Format* inspired by the query string of the HTTP(S) GET request as specified in OpenURL 0.1. The *Key/Encoded-Value ContextObject Format* defines how to represent a *ContextObject* as a concatenation of ampersand-delimited Key/Encoded-Value pairs. The foremost purpose of the *Key/Encoded-Value ContextObject Format* is backward compatibility. It provides an elegant transition from the OpenURL 0.1 specification to this Standard.

Part 3 (Sections 16 through 19) defines a *ContextObject Format* based on XML (eXtensible Markup Language). *XML Documents* are widely used in the exchange of structured text and data between computer applications. The *XML ContextObject Format* is about the future. Using the full expressive power of the XML syntax, *ContextObjects* can be described in greater detail, which *Resolvers* can use to provide more and better services.

Part 4 (Sections 20 through 22) specifies mechanisms by which *ContextObject Representations* can be transported using the HTTP(S) protocol. Collectively, these are called *OpenURL Transports.*

Communities interested in deploying new *Applications* ***should*** use Parts 2, 3 and 4 as a guideline. Deploying a new *Application* consists of the following steps:

- Register any new definitions of the following core components of the OpenURL Framework that are needed to support the *Application*: *Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats, Namespaces,* and *Transports.*
- Construct a new *Community Profile* that defines the *Application* by selecting appropriate *Registry* entries.
- Register the *Community Profile.*

Communities ***should*** create Implementation Guidelines to simplify implementation and deployment of their *Applications.*

2 Referenced Standards

This Standard references the following existing standards:

[1] *Extensible Markup Language (XML) 1.0*. [online] Third edition. 4 February 2004 [online] [cited 4 November 2004] Available from World Wide Web: <http://www.w3.org/TR/REC-xml>

[2] *Extensible Markup Language (XML)—XML Path Language (XPATH)*. Version 1.0. 16 November 1999. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.w3.org/TR/xpath>

[3] *Extensible Markup Language (XML)—XML Schema Part 1: Structures*. Second edition. 28 October 2004. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.w3.org/TR/xmlschema-1/>

[4] *Extensible Markup Language (XML)—XML Schema Part 2: Datatypes*. Second edition. 28 October 2004. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.w3c.org/TR/xmlschema-2/>

[5] IETF RFC 2119, *Keywords for use in RFCs to Indicate Requirement Levels*. March 1997. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.ietf.org/rfc/rfc2119.txt>

[6] IETF RFC 2396, *Uniform Resource Identifiers (URI): Generic Syntax*. August 1988. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.ietf.org/rfc/rfc2396.txt> (Draft revision of IETF RFC 2396 available from World Wide Web: <http://www.ietf.org/internet-drafts/draft-fielding-uri-rfc2396bis-07.txt>. New RFC number to be assigned.)

[7] Internet Assigned Naming Authority (IANA), *List of Registered Character Sets*. Last updated 2004-02-06. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.iana.org/assignments/character-sets>

[8] Internet Assigned Naming Authority (IANA), *Uniform Resource Identifier (URI) Schemes*. Last updated 10 October 2004. [online] [cited 4 November 2004] Available from World Wide Web:
<http://www.iana.org/assignments/uri-schemes>

[9] Internet Assigned Naming Authority (IANA), *Uniform Resource Names (URN) Namespaces* Last updated 10 October 2004. [online] [cited 4 November 2004] Available from World Wide Web:
<http://www.iana.org/assignments/urn-namespaces>

[10] *Data elements and interchange formats—Information interchange—Representation of dates and times*. ISO 8601:2000. Geneva: International Organization for Standardization, Switzerland, 2000.

[11] *The Unicode Standard Version 4.0*. The Unicode Consortium. Reading, MA: Addison-Wesley, 2000. Updates available from World Wide Web: <http://www.unicode.org/>

[12] *W3C Date and Time Formats*. Submitted to W3C 15 September 1997. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.w3.org/TR/NOTE-datetime>

[13] *Character Encoding Model*. Unicode Technical Report #17, Revision 5. 2004-09-09. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.unicode.org/unicode/reports/tr17>

[14] IETF RFC 2616, *Hypertext Transfer Protocol — HTTP/1.1*. June 1999. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.ietf.org/rfc/rfc2616.txt>

[15] *The mailto URL scheme*. IETF RFC 2368. The Internet Society, 1998. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.ietf.org/rfc/rfc2368.txt>

[16] *Using The ISSN (International Serial Standard Number) as URN (Uniform Resource Names) within an ISSN-URN Namespace*. IETF RFC 3044. The Internet Society, 2001. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.ietf.org/rfc/rfc3044.txt>

[17] Carl Lagoze, Herbert Van de Sompel, Michael Nelson, Simeon Warner. *The Open Archives Initiative Protocol for Metadata Harvesting.* Protocol version 2.0. Document version 2004/10/12T15:31:00Z. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.openarchives.org/OAI/2.0/openarchivesprotocol.htm>

[18] *The Dublin Core Metadata Element Set.* ANSI/NISO Z39.85-2001. Bethesda, MD: National Information Standards Organization, 2001. [online] [cited 4 November 2004] Available from World Wide Web: <http://www.niso.org/standards/resources/Z39-85.pdf>

3 Notational Conventions

The Internet Engineering Task Force (IETF) RFC 2119 [5] specifies the meaning of the following key words and key phrases: ***must***, ***must not***, ***required***, ***shall***, ***shall not***, ***should***, ***should not***, ***recommended***, ***may***, and ***optional***. When these appear in this Standard in a ***bold italic font style***, they have the meaning as specified by IETF RFC 2119:

- ***must***: This word, or the terms ***required*** or ***shall***, mean that the definition is an absolute requirement of the specification.
- ***must not***: This phrase, or the phrase ***shall not***, mean that the definition is an absolute prohibition of the specification.
- ***should***: This word, or the adjective ***recommended***, mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- ***should not***: This phrase, or the phrase ***not recommended*** mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
- ***may***: This word, or the adjective ***optional***, means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation which does not include a particular option ***must*** be prepared to interoperate with another implementation which does include the option, though perhaps with reduced functionality. In the same vein an implementation which does include a particular option ***must*** be prepared to interoperate with another implementation which does not include the option (except, of course, for the feature the option provides.)

Terms defined in this Standard will be shown in *italics* whenever this Standard uses them in the defined meaning, as in *ContextObject* or *By-Value Metadata.*

References to *Registry Identifiers* or portions of *Identifiers* are shown in **bold**, as in **info:doi/**.

Throughout this Standard, examples are provided to support a better understanding of the key terms as they are defined. The examples are excerpts from valid *Representations* of *ContextObjects.* Many examples use an informal property-list syntax in which each property is listed on a separate line and a property consists of a key term and associated value, as in:

```
<key> = <value>
```

This property-list syntax is for illustrative purposes only. It is not part of this Standard, and it ***must not*** be used to represent *ContextObjects* in *Applications*. Parts 2 and 3 formally define two *ContextObject Formats* (KEV and XML). Only *ContextObject Formats* that are formally defined in the *OpenURL Framework Registry* are available for use in an *Application.*

Tables that specify constraints use the following short-hand notation:

Constraint in short-hand	Minimum Occurrence	Maximum Occurrence
0	0	0
1	1	1
≥0	0	unbounded
≤1	0	1
≥1	1	unbounded

Some Section titles end with the suffix “[Registry]”, as in “Section 7.1 Serializations [Registry]". These Sections define core components of the OpenURL Framework, and instantiations of these core components ***must*** be registered.

This Standard uses many *Identifiers* based on the “info” URI scheme. On June 19th, 2003, representatives from NISO, NISO Committee AX, the IETF, and the W3C met to discuss the identification of resources in the OpenURL Framework. There was a consensus to proceed with the registration of a new top-level URI scheme. The first Internet-Draft for the “info” URI scheme was published on September 25th, 2003. A revision was published on December 5th, 2003. These drafts and any subsequent versions will be maintained on the <http://info-uri.info/> website. At the time of writing this Standard, the “info” URI scheme is awaiting approval by the Internet Engineering Steering Group (IESG) for publication as an informational RFC.

4 Definitions

The following terms when italicized in this Standard have the meanings indicated here:

Term	Definition
(OpenURL Framework) *Application*	A networked service environment for the transportation of *ContextObject Representations.* The core characteristics of an *Application* are specified in a *Community Profile.*
By-Reference Metadata	A *Descriptor* that details properties of an *Entity* by the combination of: (1) a URI reference to a *Metadata Format* and (2) the network location of a particular instance of metadata about the *Entity,* the metadata being expressed according to the indicated *Metadata Format.*
By-Reference OpenURL Transport	A *Transport* that uses either the HTTP or the HTTPS network protocol for conveying over a network the reference to a *ContextObject Representation.* This reference is contained in the value associated with a single key within a query string, which is transported using either a GET or POST method.
By-Value Metadata	A *Descriptor* that specifies properties of an *Entity* by the combination of: (1) a URI reference to a *Metadata Format;* and (2) a particular instance of metadata about the *Entity,* expressed according to the indicated *Metadata Format.*
By-Value OpenURL Transport	A *Transport* that uses either the HTTP or the HTTPS network protocol for conveying over a network *ContextObject Representations.* The *Representation* is contained in the value associated with a single key within a query string, which is transported using either a GET or POST method.

Term	**Definition**
Character Encoding	The combination of a character repertoire and an encoding form; a core component of the OpenURL Framework.
Community Profile	The definition of an *Application* as a list of selections for all core components of the OpenURL Framework; a core component of the OpenURL Framework.
Context	The network environment in which a *Referent* is referenced and in which a service request pertaining to the *Referent* takes place. In the *ContextObject,* the *Context* is expressed by five *Entities:* the *ReferringEntity,* the *Requester,* the *ServiceType,* the *Resolver,* and the *Referrer.*
ContextObject	An information construct that binds a description of a primary *Entity* — the referenced resource — together with descriptions of *Entities* that indicate the *Context.*
ContextObject Format	A *Format* to represent *ContextObjects;* a core component of the OpenURL Framework.
ContextObject Representation	The *Representation* of a *ContextObject* according to a *ContextObject Format.*
Constraint Definition	A *Constraint Definition* specifies syntactic and semantic constraints for the representation of a given class of resources. The constraints are specified using a *Constraint Language.*
Constraint Language	A formalism used to specify syntactic and semantic restrictions on information constructs of a given class; a core component of the OpenURL Framework.
Descriptor	A *Descriptor* specifies information about an *Entity* using one of the following four methods: *Identifier, By-Reference Metadata, By-Value Metadata,* or *Private Data.*
Entity	One of the six possible constituents of a *ContextObject: Referent, Requester, Referrer, Resolver, ReferringEntity,* or *ServiceType.*
Format	A concrete method of expression for a class of information constructs. It is a triple comprising: (1) a *Serialization,* (2) a *Constraint Language,* and (3) a *Constraint Definition* expressed in that *Constraint Language.*
Identifier	A *Descriptor* that unambiguously specifies an *Entity* by means of a URI.

Term	Definition
Inline OpenURL Transport	A *Transport* that uses either the HTTP or the HTTPS network protocol for conveying over a network the *Representation* of one, and only one, *ContextObject.* This *Representation* consists of multiple key/value pairs within a query string, which is transported using either a GET or POST method.
KEV ContextObject Format	A *ContextObject Format* to represent one, and only one, *ContextObject* as a string of ampersand-delimited pairs, each pair consisting of a key and an associated value that is URL encoded.
KEV ContextObject (Representation)	A *Representation* of a *ContextObject* that conforms to the *KEV ContextObject Format.*
KEV Metadata Format	A *Metadata Format* to represent an *Entity* as a string of ampersand-delimited pairs, each pair consisting of a key and an associated value that is URL encoded.
KEV Metadata (Representation)	A *Representation* of an *Entity* that conforms to a *KEV Metadata Format.*
KEV Serialization	A method to hold in storage, or transmit over a network, the values within an information construct as a string of ampersand-delimited pairs, each pair consisting of a key and an associated value that is URL encoded.
Metadata Format	A *Format* to create a *By-Reference Metadata Descriptor* or a *By-Value Metadata Descriptor* of an *Entity;* a core component of the OpenURL Framework.
Namespace	The set of all Uniform Resource Identifiers that comply with a specific URI scheme or a specific URN namespace; a core component of the OpenURL Framework.
Private Data	A *Descriptor* that specifies information about an *Entity* using a method not defined in this Standard.
Referent	A resource that is referenced on a network, and about which the *ContextObject* is created; an *Entity* of the *ContextObject.*
Referrer	The resource that generates the *ContextObject;* an *Entity* of the *ContextObject.*
ReferringEntity	The resource that references the *Referent;* an *Entity* of the *ContextObject.*

Term	**Definition**
(OpenURL Framework) Registry	The *Registry* provides a mechanism to record and publicize details of the core components of the OpenURL Framework: *Namespaces, Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats, Transports,* and *Community Profiles.*
Registry Identifier	A unique name assigned on registration to specific *Namespaces, Character Encodings, Serializations, Constraint Languages*, *ContextObject Formats, Metadata Formats, Transports,* and *Community Profiles.*
Representation	A sequence of bytes that represents a resource according to a *Format.*
Requester	The resource that requests services pertaining to the *Referent;* an *Entity* of the *ContextObject.*
Resolver	The resource at which a service request pertaining to the *Referent* is targeted; an *Entity* of the *ContextObject.*
Serialization	A method to hold in storage or transmit over a network the values within an information construct; a core component of the OpenURL Framework.
ServiceType	The resource that defines the type of service (pertaining to the *Referent*) that is requested; an *Entity* of the *ContextObject.*
Transport	A network protocol and the method in which it is used to convey *ContextObject Representations;* a core component of the OpenURL Framework.
XML ContextObject Format	A *ContextObject Format* to represent one or more *ContextObjects* as an *XML Document.*
XML ContextObject (Representation)	A *ContextObject Representation* that conforms to the *XML ContextObject Format.*
XML Document	A sequence of bytes that satisfies the validity requirements of the Extensible Markup Language (XML) 1.0 (Second Edition) W3C Recommendation [1].
XML Metadata (Representation)	A *Representation* of an *Entity* that conforms to an *XML Metadata Format.*
XML Serialization	The method of using an *XML Document* and *XML Format* to represent a *ContextObject.*

The OpenURL Framework for Context-Sensitive Services

Part 1: ContextObjects and Transports

Part 1 (Sections 5 through 11) defines the core components of the OpenURL Framework: *Namespaces, Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats, Transports,* and *Community Profiles.* Instances of these core components are preserved and made publicly available in the *OpenURL Framework Registry.* A community that wishes to create a new *OpenURL Framework Application* ***must*** create a new *Community Profile*. In this *Community Profile*, the community ***must*** specify instances for all core components, except the new Community Profile itself. If the *Registry* does not contain an instance of a core component needed by an *Application,* it is necessary to define and register an appropriate instance of the core component. The registration of a component makes this instance available for this or any other future *Application.* For example, if an *Application* needs to use a particular *Namespace,* that *Namespace* ***must*** be registered. Once registered, any *Application* **may** select this *Namespace* in its *Community Profile.*

Section 5 defines the *ContextObject* as an abstract information construct that consists of six *Entities: Referent, ReferringEntity, Requester, ServiceType, Resolver,* and *Referrer.* Each of these *Entities* is described using one or more *Descriptors.* There are four *Descriptor* types: *Identifier, By-Value Metadata, By-Reference Metadata,* and *Private Data.*

Section 6 defines the *OpenURL Framework Registry* and the rules that govern its usage. The *Registry* contains all instances of core components created by communities that deployed *Applications*. The *Registry* ensures that this Standard can be used in many different application domains.

Sections 7, 8, and 9 provide the framework for developing, defining, and registering methods to represent *ContextObjects* as character strings. Section 7 defines a *Format* as a triple consisting of a *Serialization,* a *Constraint Language,* and a *Constraint Definition.* Section 8 introduces *ContextObject Formats* and *Character Encodings* to represent *ContextObjects.* Section 9 introduces *Metadata Formats* and *Namespaces* to represent *Entities.*

Although *ContextObject Representations* ***may*** reside as autonomous data files in information systems, this Standard expects that *ContextObject Representations* will be transported between networked systems. Section 10 defines *Transports,* a core component of the OpenURL Framework. In a *Transport,* a community specifies how to convey over a network *ContextObject Representations.* This Standard does not restrict the purpose of the *Transport.* It is expected, however, that most *Transports* will be requests for context-sensitive services pertaining to the referenced resource (the *Referent*) and will be targeted at *Resolvers.*

A community specifies its selections for each of the core components in a *Community Profile.* This final core component of the OpenURL Framework is defined in Section 11.

5 ContextObject, Entity, and Descriptor

This Section defines the fundamental data structure of the OpenURL Framework Standard: the *ContextObject.* While this Standard does not restrict the use of the *ContextObject* to any particular environment or application, it was constructed to enable the delivery of context-sensitive services in a networked environment such as the Web.

The following scenario is used throughout this Section:

> Caltech has an institutional linker server with URI http://links.caltech.edu/menu.
>
> Jane Doe, a Caltech student with e-mail address jane.doe@caltech.edu, reads the following electronic scholarly article in the Elsevier ScienceDirect® collection:
>
> McArthur, James G. et al. 2001. p27-p16 Chimera: A Superior Antiproliferative for the Prevention of Neointimal Hyperplasia. Molecular Therapy. 3(1) 8-13. <doi:10.1006/mthe.2000.0239>
>
> In the reference list of that article, she comes across a reference to the following article:
>
> Bergelson, J. 1997. Isolation of a common receptor for coxsackie B viruses and adenoviruses 2 and 5. Science. (275) 1320-1323. <doi:10.1126/science.275.5304.1320> <pmid:9036860>

In this example, Jane Doe wants services for the Bergelson article, to which she found a reference in ScienceDirect®. Jane Doe might want the full text of the article. The full text may be available from ScienceDirect® itself, an aggregator, or Caltech's interlibrary-loan department. The full-text service therefore depends on the identity and affiliation of the Jane Doe, which are part of the context of the reference to the Bergelson article. In other cases, different contextual information may be important.

The *ContextObject* data structure captures relevant information for the delivery of context-sensitive services pertaining to a referenced resource. Based on a study of real-world OpenURL 0.1 usage, the Committee included the following in the *ContextObject* data structure:

- a description of the referenced resource itself (the Bergelson article),
- a description of the resource that makes the reference (the McArthur article), and
- a description of four other resources that are useful in fulfilling service requests pertaining to the referenced resource:
  1. the agent requesting the service (Jane Doe),
  2. the type of service that is requested (full text),
  3. the system at which the service request is targeted (Caltech linking server), and
  4. the system where the service request originates (ScienceDirect®).

The formal definition of *ContextObject* follows.

5.1 ContextObject and Entity

A *ContextObject* is a data structure that binds together descriptions of:

- A *Referent:* A resource that is referenced on a network and about which the *ContextObject* is created
- A *ReferringEntity:* The resource that references the *Referent*
- A *Requester:* The resource that requests services pertaining to the *Referent*

- A *ServiceType:* The resource that defines the type of service (pertaining to the *Referent*) that is requested
- A *Resolver:* The resource at which a service request pertaining to the *Referent* is targeted
- A *Referrer:* The resource that generates the *ContextObject*

The *ContextObject* is created to enable the delivery of services pertaining to the *Referent*, which is at the core of the *ContextObject*. The descriptions of the *ReferringEntity,* the *Requester,* the *ServiceType,* the *Resolver,* and the *Referrer* express the *Context* in which the *Referent* is referenced and in which the request for services pertaining to the *Referent* takes place.

The remainder of this Standard uses the term *Entity* to refer to any of the six types of resources that ***may*** be described in a *ContextObject*.

Example 1 uses the scenario introduced above to illustrate all *Entities* of the *ContextObject*.

Example 1: Examples of Entities

Entity	**Example**
Referent	The scholarly article by Bergelson
ReferringEntity	The scholarly article by McArthur
Requester	Jane Doe
ServiceType	Full text of the Bergelson article
Resolver	The Caltech linking server
Referrer	Elsevier's ScienceDirect®

5.2 Descriptor

A *Descriptor* specifies information about an *Entity.* This Section defines the four types of *Descriptors* that are available in this Standard: *Identifier, By-Value Metadata, By-Reference Metadata,* and *Private Data.*

5.2.1 Identifier

An *Identifier Descriptor* unambiguously specifies the *Entity* by means of a Uniform Resource Identifier (URI). This URI either points to the *Entity* itself or to metadata that specify the *Entity*.

Example 2: Identifiers for a Referent, Requester, and Resolver

```
rft_id = info:doi/10.1126/science.275.5304.1320
rft_id = info:pmid/9036860
req_id = mailto:jane.doe@caltech.edu
res_id = http://links.caltech.edu/menu
```

Example 2 shows *Identifier Descriptors* for a *Referent* (the Bergelson article), a *Requester* (Jane Doe), and a *Resolver* (the Caltech linking server) using the informal property-list syntax of Section 3. The key names (**rft_id**, for example) resemble those introduced in Part 2 of this Standard. However, Part 1 of this Standard uses these names for illustration only and does not formally define them.

The Digital Object Identifier (DOI) **10.1126/science.275.5304.1320** identifies the Bergelson article. As such, the URI **info:doi/10.1126/science.275.5304.1320** is an *Identifier Descriptor* for the *Referent.* The PubMed identifier **9036860** identifies metadata for the Bergelson article. Therefore, the URI **info:pmid/9036860** is also an *Identifier Descriptor* for the *Referent.*

The e-mail address **jane.doe@caltech.edu** describes Jane Doe. The corresponding URI **mailto:jane.doe@caltech.edu** is an *Identifier Descriptor* for this *Requester.*

The URI **http://links.caltech.edu/menu** describes the institutional linking server at Caltech and is an *Identifier Descriptor* for this *Resolver.*

5.2.2 By-Value Metadata

A *By-Value Metadata Descriptor* specifies properties of the *Entity* by the combination of: (1) a URI reference to a *Metadata Format;* and (2) a particular instance of metadata about the *Entity* expressed according to this *Metadata Format.*

Example 3: By-Value Metadata for a Referent

```
rft_val_fmt = info:ofi/fmt:kev:mtx:journal
rft.aulast = Bergelson
rft.auinit = J
rft.date = 1997
rft.atitle = Isolation of a common receptor for coxsackie B viruses and
adenoviruses 2 and 5
rft.jtitle = Science
rft.volume = 275
rft.spage = 1320
rft.epage = 1323
```

Example 3 shows a *By-Value Metadata Descriptor* for a *Referent,* the Bergelson article.

The URI specified as the value of the **rft_val_fmt** key (**info:ofi/fmt:kev:mtx:journal**) identifies the *Metadata Format* used to describe the Bergelson article. Sections 6, 7, and 8 explain how to construct and interpret *Registry Identifiers* for *Formats,* such as **info:ofi/fmt:kev:mtx:journal**. This particular *Registry Identifier* identifies a *Metadata Format* for a journal article.

The remaining lines in Example 3 are metadata properties for the *Referent.* The metadata keys (**aulast**, **auinit**, **date**, etc.) are from the identified *Metadata Format* for a journal article. The metadata keys are prefixed with **rft.** to indicate that the metadata describe the *Referent.*

5.2.3 By-Reference Metadata

A *By-Reference Metadata Descriptor* specifies properties of the *Entity* by the combination of: (1) a URI reference to a *Metadata Format;* and (2) the network location — specified by means of a URI — of a particular instance of metadata about the *Entity* expressed according to this *Metadata Format.*

Example 4: By-Reference Metadata for a Requester

```
req_ref_fmt = http://lib.caltech.edu/mxt/ldap.html
req_ref = ldap://ldap.caltech.edu:389/janed
```

Example 4 shows a *By-Reference Metadata Descriptor* for a *Requester,* Jane Doe. The value associated with the **req_ref** key is a pointer to (or network location of) Jane Doe's entry in the Caltech LDAP directory server. The value of the **req_ref_fmt** key specifies the *Metadata Format* of the document to which the value of the **req_ref** key points.

5.2.4 Private Data

A *Private Data Descriptor* specifies information about the *Entity* using a method not defined in this Standard. This Standard does not provide any global mechanisms to interpret *Private Data.* Instead, it is assumed that the *Resolver* and the *Referrer* have a common understanding, based on a tacit or explicit bilateral agreement. To make it possible for the *Resolver* to interpret *Private Data,* a *ContextObject* that contains *Private Data* ***should*** identify the *Referrer* that created it.

Example 5: Private Data for a Referent

```
rft_dat = cites/8///citedby/12
rfr_id = info:sid/elsevier.com:ScienceDirect
```

Example 5 shows a *Private Data Descriptor* for a *Referent.* The value associated with the **rft_dat** key, **cites/8///citedby/12**, is *Private Data* provided about the *Referent.* The value associated with the **rfr_id** key, **info:sid/elsevier.com:ScienceDirect**, is an *Identifier Descriptor* of the *Referrer.* Knowing the identity of the *Referrer* might help the *Resolver* to interpret the *Private Data.*

5.3 Constraints

The number of occurrences of each *Entity* that ***may*** be present in a *ContextObject* is constrained:

- A *ContextObject* ***must*** contain exactly one *Referent.*
- A *ContextObject* ***may*** contain at most one *ReferringEntity, Requester,* and *Referrer.*
- A *ContextObject* ***may*** contain zero or more *ServiceTypes* and *Resolvers.*

These fundamental constraints are summarized in the first two columns of Table 1.

The remaining columns of Table 1 indicate that:

- All four *Descriptors* ***may*** be used to describe each of the *Entities.*
- Each type of *Descriptor* ***may*** be used zero or more times for the description of a specific *Entity.* No ordering or priority is defined for multiple *Descriptors.*

Table 1: Fundamental ContextObject Constraints

Entity	Number	Descriptors			
		Identifier	By-Value Metadata	By-Reference Metadata	Private Data
Referent	1	≥ 0	≥ 0	≥ 0	≥ 0
ReferringEntity	≤ 1	≥ 0	≥ 0	≥ 0	≥ 0
Requester	≤ 1	≥ 0	≥ 0	≥ 0	≥ 0
ServiceType	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0
Resolver	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0
Referrer	≤ 1	≥ 0	≥ 0	≥ 0	≥ 0

ContextObject Formats that define specific methods to represent *ContextObjects* (see Section 8.2) ***must not*** relax the constraints expressed in Table 1, but they ***may*** restrict them:

- A *ContextObject Format* ***may*** limit the number of occurrences of *ServiceType* and *Resolver Entities.*
- A *ContextObject Format* ***may*** limit the number of *Descriptors* that ***may*** be used to describe each *Entity.*
- A *ContextObject Format* ***must not*** allow multiple *Referent, ReferringEntity, Requester,* or *Referrer Entities.*

Any additional constraints ***must*** be specified in *ContextObject Format* definitions.

When one *Entity* of a *ContextObject* is described by multiple *Descriptors,* those *Descriptors* ***must*** describe the same resource. For example, when a *ContextObject* contains two *Identifier Descriptors* and one *By-Value Metadata Descriptor* for one *Referent Entity,* all three *Descriptors* ***must*** describe the same *Referent.*

When there are multiple occurrences of the same *Entity* in one *ContextObject,* each occurrence ***must*** represent a different resource. These multiple occurrences ***must not*** be interpreted as variant descriptions of the same resource. For example, two *Resolver Entities* contained in one *ContextObject* ***must*** represent two distinct *Resolvers.* In this case, each *Resolver Entity* ***may*** have multiple *Descriptors,* each of which ***must*** be a variant description of the same *Resolver.*

ContextObject Formats that allow multiple occurrences of *ServiceType* and/or *Resolver Entities* ***must*** define how multiple *Descriptors* are grouped to bind to particular *Entities.*

The basic data model for *ContextObjects* does not constrain the number of *ContextObjects* that ***may*** be represented in an instance document that conforms to the *ContextObject Format. ContextObject Formats* ***may*** constrain this number, and each *Community Profile* provides this information (see Sections 11, 15, and 19).

6 Registry

This Section defines the OpenURL Framework Registry, referred to as the *Registry* in the remainder of this Standard. It is based at <http://www.openurl.info/registry>.

Upon approval of this Standard, NISO will establish one or more Maintenance Agencies for the *Registry.* The responsibilities and duties for Maintenance Agencies of the OpenURL Framework Standard are specified in Appendix A.

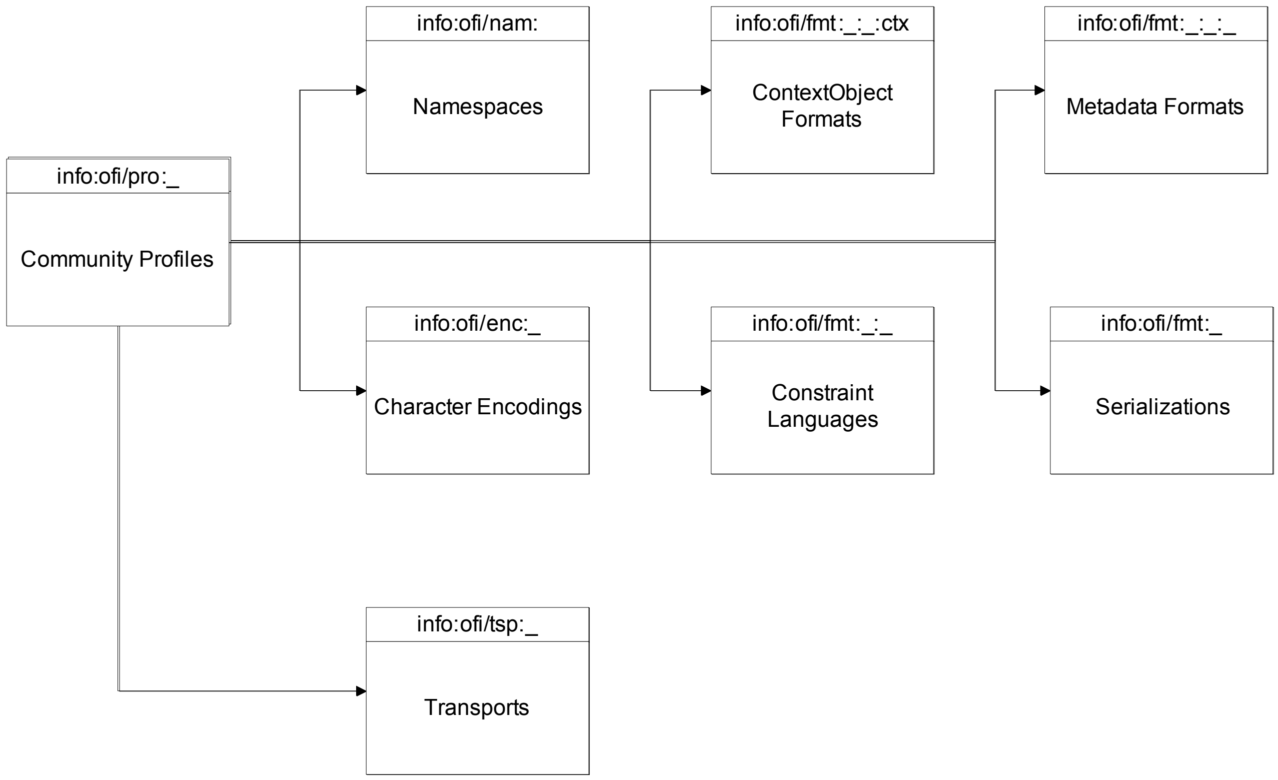
6.1 Registry Entries

When a community defines an *Application,* it ***must*** specify selections for each of the core components of the OpenURL Framework:

- For representing *ContextObjects:*
  - *Character Encodings* (one or more)
  - *Serializations* (one)
  - *Constraint Languages* (one)
  - *ContextObject Formats* (one)
- For representing *Entities* of *ContextObjects:*
  - *Namespaces* (zero or more)
  - *Metadata Formats* (zero or more)
- For transporting *ContextObject Representations:*
  - *Transports (one or more)*
- For defining *Applications:*
  - *Community Profiles (one)*

Figure 1 illustrates the structure of the *Registry* and shows how *Community Profiles* define the characteristics of an *Application* by listing community-specific selections for the core components of the OpenURL Framework.

Figure 1: Core Components of the OpenURL Framework



Example 6: A Registry Entry

info:ofi/nam:info:doi:	
dc:title	Namespace for Digital Object Identifiers
dc:creator	International DOI Foundation
dc:date	2004-01-01
dc:identifier	http://errol.oclc.org/info-uri.info/info:doi/?metadataPrefix=reg
dc:identifier	http://errol.oclc.org/info-uri.info/info:doi/.reg
dc:identifier	info:doi/

Example 6 shows a *Registry* entry that describes an instance of a *Namespace,* a core component of the OpenURL Framework introduced in Section 9.1. This entry describes the *Namespace* of Digital Object Identifiers (DOI), which is introduced in Appendix C. The top row displays the *Registry Identifier* of the *Registry* entry, and remaining rows use Dublin Core metadata [18] to describe the *Registry* entry (see Sections 6.2 and 6.3).

Part 1 is concerned with the OpenURL Framework; it does not register specific instances of core components. In Parts 2, 3, and 4 and Appendices Appendix B, Appendix C, and Appendix D, this Standard defines, registers, and uses specific instances of core components. However, *Registry* entries in this Standard are provided for illustrative purposes only and are often only partially displayed. For example, the **dc:date** field is usually omitted as it is 2004-01-01 for all entries in the initial *Registry.* The authoritative *Registry* entries are in the online *Registry* at <http://www.openurl.info/registry/>.

6.2 Registry Identifiers

Upon registration, each instance of a core component receives a unique *Registry Identifier,* which is a URI of the form **info:ofi/<u>char-string</u>**, where:

- **info** is the name of the URI scheme;
- **ofi** represents the namespace under the **info scheme** reserved for *Registry Identifiers;* and
- **<u>char-string</u>** ***must*** be replaced by a unique character string assigned by the *Registry* upon registration of the instance of the core component.

Table 2 summarizes where to find information related to *Registry Identifiers* for core components. The first column lists core components. The second column displays the structure of their *Registry Identifiers.* The third column lists which Section defines each core component. The fourth and fifth columns (with KEV and XML heading, respectively) give the Sections and Appendices where instances of core components are introduced. This Standard initializes the *Registry* with entries that bootstrap two *Applications* for the scholarly-information community: one *Application* based on the *KEV ContextObject Format* and one based on the *XML ContextObject Format.* These entries ***may*** also be used by other communities.

Table 2: Core Components and their Registry Identifiers

Core Component	Registry Identifier Structure	Framework	KEV	XML
Serializations	**info:ofi/fmt:_**	7.1	12.1	16.1
Constraint Languages	**info:ofi/fmt:_:_**	7.2	12.2	16.2
Character Encodings	**info:ofi/enc:_**	8.1	13.3	17.4
ContextObject Formats	**info:ofi/fmt:_:_:ctx**(1)	8.2	12.3.1	17.3
Namespaces	**info:ofi/nam:_**	9.1	C.5	D.5
Metadata Formats	**info:ofi/fmt:_:_:_** (2)	9.2	14.2	18.2
Transports	**info:ofi/tsp:_**	10	20, 21 22	20, 21
Community Profiles	**info:ofi/pro:_**	11	15, Appendix C	19, Appendix D

(1) The last component of *Registry Identifiers* for *ContextObject Formats* ***must*** start with the reserved prefix **ctx**.

(2) The last component of *Registry Identifiers* for *Metadata Formats* ***must not*** be named with the reserved prefix **ctx**.

6.3 Using the Registry

Given the *Registry Identifier* of a *Registry* entry, it is possible to obtain the Dublin Core metadata description and the actual definition of the entry. (In the URIs shown below, replace the bold and underlined keyword **<u>registry-identifier</u>** with the *Registry Identifier* of the *Registry* entry.)

The Dublin Core metadata description [18] of the entry is available in two forms:

- for display in a web browser: <http://www.openurl.info/registry/dc/**<u>registry-identifier</u>**>
- for direct access: <http://www.openurl.info/registry/docs/dc/**<u>registry-identifier</u>**>

The Dublin Core metadata ***may*** include **dc:identifier** fields, each containing a URI that points to a definition of the *Registry* entry. This mechanism provides access to multiple forms of the definition.

The following standard form URI always resolves to a definition of the registered resource:

- <http://www.openurl.info/registry/docs/**registry-identifier**>

If there are one or more **dc:identifier** fields in the *Registry* entry, the standard form URI resolves to the URI contained in the first **dc:identifier** field. There is no standard form URI available to access definitions pointed to by URIs in subsequent **dc:identifier** fields.

In Example 6, the *Registry Identifier* of the DOI *Namespace* is **info:ofi/nam:info:doi:**, and its Dublin Core metadata description is available in two forms:

- for display in a web browser: <http://www.openurl.info/registry/dc/info:ofi/nam:info:doi:>
- for direct access: <http://www.openurl.info/registry/docs/dc/info:ofi/nam:info:doi:>

The standard form URI <http://www.openurl.info/registry/docs/info:ofi/nam:info:doi:> refers to the definition of the registered resource itself (the DOI *Namespace*), which is described by the Dublin Core metadata shown above.

Because there are one or more **dc:identifier** fields in this *Registry* entry, a resolution mechanism redirects the standard form URI to the URI in the first **dc.identifier** field. This URI, <http://errol.oclc.org/info-uri.info/info:doi/?metadataPrefix=reg>, resolves to a browser display of the definition of the DOI *Namespace* under the “info” URI scheme.

The URI in the second **dc:identifier** field, <http://errol.oclc.org/info-uri.info/info:doi/.reg>, points to the raw XML record defining the DOI *Namespace* under the “info” URI scheme (as opposed to the HTML rendition of this record).

The URI in the third **dc:identifier** field points to the info:doi/ namespace in the “info” URI scheme.

In the initial *Registry,* URIs following the pattern <http://www.openurl.info/registry/docs/**registry-identifier**> are reserved for “native forms”, while the rest of the *Registry* is suitable for web browsing. The initial *Registry* contains the following entry types stored inside the *Registry:*

- Items described by Dublin Core metadata formatted for web browsing use the URI pattern <http://www.openurl.info/registry/dc/**registry-identifier**>. These same items in their native form use the URI pattern <http://www.openurl.info/registry/docs/dc/**registry-identifier**>. In this case, the native form is an *XML Document* that conforms to the XML Schema located at <http://www.openarchives.org/OAI/2.0/oai_dc.xsd>.
- In Section 11, an XML Schema to define *Community Profiles* will be introduced. Web-browsable definitions of *Community Profiles* will use the URI pattern <http://www.openurl.info/registry/pro/**registry-identifier**>, and XML-based definitions will use the URI pattern <http://www.openurl.info/registry/docs/pro/**registry-identifier**>.
- In Part 2, Z39.88-2004 Matrix *Constraint Definitions* for *Registry* entries related to the *KEV ContextObject Format* will use the URI patterns <http://www.openurl.info/registry/mtx/**registry-identifier**> and <http://www.openurl.info/registry/docs/mtx/**registry-identifier**>.
- In Part 3, XML Schema *Constraint Definitions* for *Registry* entries related to the *XML ContextObject Format* will use the URI pattern <http://www.openurl.info/registry/xsd/**registry-identifier**> for web-browsable displays and the URI pattern <http://www.openurl.info/registry/docs/xsd/**registry-identifier**> for XML Schemas.

The initial *Registry* supports the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) [17] as a machine interface for downloading *Registry* materials.

7 Formats

To enable the use of a wide variety of *Representations* of *ContextObjects* and their *Entities,* this Standard defines the notion of a *Format.*

A *Format* is a method to represent information constructs as character strings.

Each *Format* consists of a *Serialization,* a *Constraint Language,* and a *Constraint Definition* expressed using the *Constraint Language.* In this Standard, the set of three items defining a *Format* is called a triple and is represented by a short-hand notation as in:

{ *Serialization, Constraint Language, Constraint Definition* }

In Section 8.2, the *Format* notion is used to define *ContextObject Format,* which gives communities the ability to define, register, and use *ContextObject Representations* that are the most appropriate for their application domain. In Section 9.2, the *Format* notion is used to define *Metadata Format,* which gives communities the ability to define, register, and use appropriate methods to describe *Entities* of *ContextObjects* by means of *By-Value* or *By-Reference Metadata Descriptors.*

7.1 Serializations [Registry]

For representing *ContextObjects* and their *Entities,* this Standard supports the use of a variety of *Serializations.*

A *Serialization* is a method by which structured information can be held in storage and/or can be transmitted over a network.

The description of a resource, such as a *ContextObject* or an *Entity,* is often a hierarchical and complex structure at the conceptual level. The form in which it is stored and/or transmitted over a network, however, is a simple character string. An example of such a storage and/or transmission form is XML.

Serializations ***must*** be registered before use in an *Application.*

Communities ***may*** use *Serializations* that are already in the *Registry,* or they ***may*** register additional *Serializations* as needed.

Upon registration, a *Serialization* is assigned a *Registry Identifier,* formed by concatenating three character strings:

- **info:ofi/**, which represents the namespace under the **info** scheme reserved for *Registry Identifiers*
- **fmt:**, the character string used to introduce *Format*-related *Identifiers* in the **info:ofi/** *Namespace*
- a character string that is assigned on registration and identifies the *Serialization.*

Registry Identifiers of *Serializations* are used to support *Registry* management and to identify *Serializations* in *Community Profiles.* In typical use, *Registry Identifiers* of *Serializations* do not show up in *Representations* of *ContextObjects* or their *Entities.*

Table 3: Registry Identifiers for Serializations

“info” URI Namespace	Format-related	Serialization	Registry Identifier
info:ofi/	**fmt:**	**kev**	**info:ofi/fmt:kev**
info:ofi/	**fmt:**	**xml**	**info:ofi/fmt:xml**

Table 3 illustrates the construction of *Registry Identifiers* for the two *Serializations* in the initial *Registry:*

- KEV: A resource is represented as a string of ampersand-delimited pairs, each pair consisting of a key and an associated URL-encoded value. In the remainder of this Standard, Key/Encoded-Value is abbreviated as KEV. (See Section 12.1.)

- XML: A resource is represented as an *XML Document.* (See Section 16.1.)

7.2 Constraint Languages [Registry]

For expressing syntactic and semantic constraints on the representation of *ContextObjects* and their *Entities,* this Standard supports the use of a variety of *Constraint Languages.*

A *Constraint Language* is a method to specify syntactic and semantic restrictions on information constructs of a given class that are to be serialized. Each *Constraint Language* is tied to one *Serialization.*

Constraint Languages ***must*** be registered before use in an *Application.*

Communities ***may*** use *Constraint Languages* that are already in the *Registry,* or they ***may*** register additional *Constraint Languages* as needed.

Upon registration, a *Constraint Language* is assigned a *Registry Identifier,* formed by concatenating four character strings:

- **info:ofi/**, which represents the namespace under the **info** scheme reserved for *Registry Identifiers*
- **fmt:**, the character string to introduce *Format*-related *Identifiers* in the **info:ofi/** *Namespace*
- a character string that identifies the registered *Serialization* to which the *Constraint Language* is tied followed by a colon character (':')
- a character string that is assigned on registration and identifies the *Constraint Language.*

Registry Identifiers of *Constraint Languages* are used to support *Registry* management and to identify *Constraint Languages* in *Community Profiles.* In typical use, *Registry Identifiers* of *Constraint Languages* do not show up in *Representations* of *ContextObjects* or their *Entities.*

Table 4: Registry Identifiers for Constraint Languages

"info" URI Namespace	Format-related	Serialization	Constraint Language	Registry Identifier
info:ofi/	**fmt:**	**kev:**	**mtx**	**info:ofi/fmt:kev:mtx**
info:ofi/	**fmt:**	**xml:**	**xsd**	**info:ofi/fmt:xml:xsd**

Table 4 illustrates the construction of *Registry Identifiers* for the two *Constraint Languages* in the initial *Registry* (see Sections 12.2 and 16.2):

- Z39.88-2004 Matrix: This *Constraint Language,* which is defined in Appendix B, defines how to construct a matrix that specifies how to describe a specific class of resources using a string of ampersand-delimited KEV pairs. For an example of a matrix that defines a *KEV Metadata Format,* see Section 12.3.2.
- XML Schema: The W3C XML Schema definition language is endorsed by the World Wide Web Consortium (W3C) to describe the structure and constrain the contents of XML 1.0 documents [3] [4]. For an example of the use of an XML Schema that defines an *XML Metadata Format,* see Section 16.3.2.

7.3 Constraint Definitions

A *Constraint Definition* specifies syntactic and semantic constraints for the *Representation* of a given class of resources. The constraints are specified using a *Constraint Language.*

This Standard uses two types of *Constraint Definitions.* Section 8.2 uses one type to constrain *Representations* of *ContextObjects,* leading to *ContextObject Formats.* Section 9.2 uses another type to constrain *Representations* of *Entities* of *ContextObjects,* leading to *Metadata Formats,* which enable *By-Value* and *By-Reference Metadata Descriptors.*

Section 12.3 shows how to use the Z39.88-2004 Matrix *Constraint Language* to define constraints on *KEV Serializations.* Tables Table 13and Table 14 show excerpts of *Constraint Definitions* of, respectively, the *KEV ContextObject Format* and the *KEV Metadata Format* for items of the type "book".

Section 16.3 shows how to use the XML Schema *Constraint Language* to define constraints on *XML Serializations.* Tables Table 18 and Table 19 show XML Schema *Constraint Definitions* of, respectively, the *XML ContextObject Format* and the *XML Metadata Format* for items of the type "journal".

8 Representing ContextObjects

This Section defines two core components of the OpenURL Framework that are essential for the *Representation* of *ContextObjects: Character Encodings* and *ContextObject Formats.*

8.1 Character Encodings [Registry]

For the *Representation* of *ContextObjects,* this Standard supports the use of a variety of Character Repertoires and Encoding Forms as defined in Character Encoding Model [13].

A *Character Encoding* is a combination of a Character Repertoire and an Encoding Form.

All *Character Encodings* used in *Applications* ***must*** be taken from the Internet Assigned Naming Authority (IANA) List of Registered Character Sets [7]. When a *ContextObject Representation* declares that it is using a specific *Character Encoding,* it ***must*** follow the specification of the corresponding IANA character set, as shown in the IANA list.

All *Character Encodings* ***must*** be registered before use in an *Application.*

Communities ***may*** use *Character Encodings* that are already in the *Registry,* or they ***may*** register additional *Character Encodings* from the IANA list as needed.

Upon registration, a *Character Encoding* is assigned a *Registry Identifier,* formed by concatenating three character strings:

- **info:ofi/**, which represents the namespace under the **info** scheme reserved for *Registry Identifiers*
- **enc:**, a character string that uniquely identifies a core component of the OpenURL Framework, which for *Character Encodings* ***must*** be **enc:**
- a character string that identifies the IANA character set [7]. Use the character string in the official IANA definition that is tagged as
    - "preferred MIME name", if available, or
    - "Name", if a preferred MIME name is not available.

Registry Identifiers of *Character Encodings* are typically used to declare the *Character Encoding* of a *ContextObject Representation.* They are also used to support *Registry* management and to identify *Character Encodings* in *Community Profiles.*

Table 5: Registry Identifiers for Character Encodings

"info" URI Namespace	Core Component	IANA preferred MIME name	IANA Name	Registry Identifier
info:ofi/	**enc:**		**UTF-8**	**info:ofi/enc:UTF-8**
info:ofi/	**enc:**	**Big5**	**Big5**	**info:ofi/enc:Big5**
info:ofi/	**enc:**	**ISO-8859-1**	**ISO_8859-1:1987**	**info:ofi/enc:ISO-8859-1**

Table 5 shows how to construct *Registry Identifiers* for the *Character Encodings* in the initial Registry: ISO 8859-1 (ISO Latin 1), UTF-8 encoded Unicode, and Big5.

Example 7: Identification of a Character Encoding

```
  ctx_enc = info:ofi/enc:UTF-8
```

Example 7 shows how a *KEV ContextObject Representation* specifies its *Character Encoding* by assigning the *Registry Identifier* of the *Character Encoding* to the **ctx_enc** administrative key.

8.2 ContextObject Formats [Registry]

A *ContextObject Format* is a specification of concrete selections for all three items of the *Format* triple { *Serialization, Constraint Language, Constraint Definition* } for the purpose of representing *ContextObjects.*

ContextObject Formats ***must not*** relax the constraints expressed in Table 1, but they ***may*** restrict them:

- A *ContextObject Format* ***may*** limit the number of occurrences of *ServiceType* and *Resolver Entities.*
- A *ContextObject Format* ***may*** limit the number of *Descriptors* that ***may*** be used to describe each *Entity.*
- A *ContextObject Format* ***must not*** allow multiple *Referent, ReferringEntity, Requester,* or *Referrer Entities.*

Any additional constraints ***must*** be specified in *ContextObject Format* definitions.

The basic data model for *ContextObjects* does not constrain the number of *ContextObjects* that ***may*** be represented in an instance document that conforms to the *ContextObject Format. ContextObject Formats* ***may*** constrain this number, and each *Community Profile* provides this information. (See Sections 11, 15, and 19.)

It is recommended that a *ContextObject Format* provide the capability to convey administrative information. The *Registry* ***may*** require providing this capability.

ContextObject Formats ***must*** be registered before use in an *Application.*

Communities ***may*** use *ContextObject Formats* that are already in the *Registry,* or they ***may*** register additional *ContextObject Formats* as needed.

Upon registration, a *ContextObject Format* is assigned a *Registry Identifier,* formed by concatenating three character strings:

- **info:ofi/**, which represents the namespace under the **info** scheme reserved for *Registry Identifiers*

- **fmt:**, a character string used to introduce *Format*-related *Identifiers* in the **info:ofi/** *Namespace*
- a character string that identifies the *Format* triple for the *ContextObject Format,* consisting of:
  - a character string that identifies the registered *Serialization* followed by a colon character (':')
  - a character string that identifies the registered *Constraint Language* followed by a colon character (':')
  - a character string that is assigned on registration and identifies the *Constraint Definition.* It ***must*** start with the reserved prefix **ctx** to indicate that this is a *ContextObject Format.*

Registry Identifiers of *ContextObject Formats* are used in *ContextObject Representations* to specify the *Format* by which the *ContextObjects* are represented. *Registry Identifiers* of *ContextObject Formats* are also used to support *Registry* management and to identify *ContextObject Formats* in *Community Profiles.*

Table 6: Registry Identifiers for ContextObject Formats

"info" URI Namespace	Format-related	Serialization	Constraint Language	Constraint Definition	Registry Identifier
info:ofi/	**fmt:**	**kev:**	**mtx:**	**ctx**	**info:ofi/fmt:kev:mtx:ctx**
info:ofi/	**fmt:**	**xml:**	**xsd:**	**ctx**	**info:ofi/fmt:xml:xsd:ctx**

Table 6 illustrates the construction of *Registry Identifiers* for the two *ContextObject Formats* in the initial *Registry* (described in Sections 12 and 16, respectively):

- The *KEV ContextObject Format* represented by the triple:
  { KEV, Z39.88-2004 Matrix, matrix of Table 13 }.
  - The *KEV ContextObject Format* represents a *ContextObject* as a string of ampersand-delimited KEV pairs, constrained using the Z39.88-2004 Matrix of Table 13.
  - The *KEV ContextObject Format* restricts the number of *ServiceType* and *Resolver Entities* to "≤1" and the number of *Referrer Entities* to exactly one*.* (See Table 15.)
  - The *KEV ContextObject Format* includes the capability to convey administrative information; see Table 17.
- The *XML ContextObject Format* represented by the triple:
  { XML, XML Schema, XML Schema of Section 16.2 }.
  - The *XML ContextObject Format* represents one or more *ContextObjects* as an *XML Document,* constrained using the XML Schema *Constraint Language* by means of the XML Schema of Section 16.2.
  - The XML *ContextObject Format* restricts the number of *Referrer Entities* to exactly one; see Table 20.
  - The XML *ContextObject Format* includes the capability to convey administrative information; see Table 22.
  - To support new applications, communities could introduce new XML-based *ContextObject Formats* constrained by other syntactic constraint languages (DTD or RELAX NG, for example) or semantic constraint languages (RDFS or OWL, for example).

Example 8: Identification of a ContextObject Format

```
  url_ctx_fmt = info:ofi/fmt:kev:mtx:ctx
```

Example 8 shows how a *Registry Identifier* of a *ContextObject Format* is used as the value of an **url_ctx_fmt** key of an *OpenURL Transport* (see Part 4) to specify the *Format* of the transported *ContextObject Representation.*

9 Representing Entities

This Section defines core components of the OpenURL Framework that are essential for the representing *Entities* of *ContextObjects:*

- *Namespaces* for describing *Entities* with *Identifier Descriptors*
- *Metadata Formats* for describing *Entities* with *By-Value* and/or *By-Reference Metadata Descriptors*

Entities ***may*** also be described by *Private Data Descriptors.* Because the nature of *Private Data* is not specified by this Standard, there is no infrastructure in the OpenURL Framework to support *Private Data:* none of the core components explicitly deal with *Private Data,* and *Community Profiles* do not contain any information to facilitate the use of *Private Data* in *Applications.*

The *Metadata Format* used to represent an *Entity* ***must*** be compatible with the *ContextObject Format* used to represent the *ContextObject* that contains the *Entity.* In most cases, the *Metadata Format* and the *ContextObject Format* ***must*** be based on the same *Serialization* and *Constraint Language.* This requirement is waived only if the *Entity* is described with a *By-Reference Metadata Descriptor* and the *Metadata Format* is registered.

In most cases, a *Character Encoding* used for the *Representation* of an *Entity* and the *Character Encoding* used for the *Representation* of the *ContextObject* that contains the *Entity* ***must*** be identical. This requirement is waived only for *By-Reference Metadata,* provided that it contains a standards-based declaration of its *Character Encoding.* In this case, the *Character Encoding* of the *By-Reference Metadata* ***may*** differ from that of the *ContextObject.* However, this is strongly discouraged, because it is not guaranteed that *Resolvers* will be able to process in a meaningful way the *Character Encoding* specified in the *By-Reference Metadata.*

9.1 Namespaces [Registry]

Identifier Descriptors describe *Entities* with *Identifiers.* This Standard provides for the use of *Identifiers* from a wide variety of namespaces. This Section defines which *Identifiers* are valid according to this Standard.

All *Identifiers* used in *OpenURL Framework Applications* ***must*** be Uniform Resource Identifiers (URIs) or Uniform Resource Names (URNs). URI schemes and URN namespaces are maintained by the Internet Assigned Numbers Authority (IANA) and are available at:

- IANA URI Schemes Registry [8]: <http://www.iana.org/assignments/uri-schemes>
- IANA URN Namespace Identifiers Registry [9]: <http://www.iana.org/assignments/urn-namespaces>

URI schemes or URN namespaces ***must*** be registered before use in an *Application.*

Registered URI schemes and URN namespaces are called *Namespaces.* This Standard does not support the use of unregistered *Namespaces.* Only *Identifiers* that belong to a registered *Namespace* ***may*** be used in *Identifier Descriptors* of *Entities.*

Communities ***may*** use *Namespaces* that are already in the *Registry,* or they ***may*** register additional *Namespaces* as needed.

Upon registration, a *Namespace* is assigned a *Registry Identifier*, formed by concatenating three character strings:

- **info:ofi/**, which represents the namespace under the **info** scheme reserved for *Registry Identifiers*
- **nam:**, a character string that uniquely identifies a core component of the OpenURL Framework, which for *Namespaces* ***must*** be **nam:**
- a character string indicating the actual URI scheme or URN namespace:
  - For URI schemes, use the string listed under the Column "Scheme Name" of the IANA URI Schemes registry [8].
  - For URN namespaces, use the character string **urn:** followed by the string listed under the Column "Registered Formal URN Namespaces" of the IANA URN Namespaces registry [9].

Registry Identifiers of *Namespaces* are used primarily to support *Registry* management and to identify *Namespaces* in *Community Profiles.* In typical use, *Registry Identifiers* of *Namespaces* do not show up in *Representations* of *ContextObjects* or their *Entities.*

Table 7: Registry Identifiers for Namespaces

"info" URI Namespace	Core Component	URI Scheme or URN Namespace	Registry Identifier	Namespace
info:ofi/	**nam:**	**http**	**info:ofi/nam:http**	http URI Scheme (RFC 2616 [14)
info:ofi/	**nam:**	**mailto**	**info:ofi/nam:mailto**	mailto URI Scheme (RFC 2368 [15])
info:ofi/	**nam:**	**urn:ISSN**	**info:ofi/nam:urn:ISSN**	ISSN URN Namespace (RFC 3044 [16])

Table 7 illustrates the construction of *Registry Identifiers* for three *Namespaces.* For a list of all *Namespaces* in the initial *Registry,* see Sections C.5 and D.5.

Example 9: Identification of Entities using Identifiers from Namespaces

```
rft_id = urn:ISBN:0262011808
rft_id = info:pmid/9036860
req_id = mailto:jane.doe@caltech.edu
rfr_id = http://www.sciencedirect.com
```

Example 9 shows *Identifiers* used as *Descriptors* of two *Referents,* a *Requester,* and a *Referrer.* The *Identifier* **mailto:jane.doe@caltech.edu** belongs to the *Namespace* for the "mailto" URI Scheme, which was assigned the *Registry Identifier* **info:ofi/nam:mailto** upon registration.

9.2 Metadata Formats [Registry]

A *Metadata Format* is a specification of concrete selections for all three items of the *Format* triple { *Serialization, Constraint Language, Constraint Definition* } for the purpose of representing an *Entity.*

Metadata Formats define Formats that can be used for the *Representation* of *Entities* of *ContextObjects* by means of *By-Value* and/or *By-Reference Metadata Descriptors.*

Metadata Formats used in *Applications* ***should*** be registered. This Standard recommends the use of registered *Metadata Formats* when feasible, but it supports the use of unregistered *Metadata Formats* that meet the requirements described below.

A *Metadata Format* used to represent an *Entity* ***must*** be compatible with the *ContextObject Format* used to represent the *ContextObject* that contains the *Entity.* In most cases, the *Metadata Format* and the *ContextObject Format* ***must*** be based on the same *Serialization* and *Constraint Language.* This requirement is waived only if the *Entity* is described with a *By-Reference Metadata Descriptor* and the underlying *Metadata Format* is registered.

Communities ***may*** use *Metadata Formats* that are already in the *Registry,* they ***may*** register additional *Metadata Formats,* or they ***may*** use unregistered *Metadata Formats.*

Upon registration, a registered *Metadata Format* is assigned a *Registry Identifier,* formed by concatenating three character strings:

- **info:ofi/**, which represents the namespace under the **info** scheme reserved for *Registry Identifiers*
- **fmt:**, a character string used to introduce *Format*-related *Identifiers* in the **info:ofi/** *Namespace*
- a character string that identifies the *Format* triple. It consists of:
  - a character string that identifies the registered *Serialization* followed by a colon character (':')
  - a character string that identifies the registered *Constraint Language* followed by a colon character (':')
  - a character string that is assigned on registration and associates a name with the *Metadata Format.* This name ***must not*** start with the prefix **ctx**, which is reserved for *ContextObject Formats.* The name of the *Metadata Format* ***may*** be non-unique in the *Registry* but the *Registry Identifier* ***must*** be unique to the *Registry.* No relationship is assumed between *Metadata Formats* with the same or similar names.

Registry Identifiers of registered *Metadata Formats* are used in *ContextObject Representations* to specify the *Format* by which the *Entities* in the *ContextObjects* are represented. *Registry Identifiers* of *Metadata Formats* are also used to support *Registry* management and to identify registered *Metadata Formats* in *Community Profiles.*

An unregistered *Metadata Format* ***must*** be identified by means of a URI. This URI

- ***must not*** reside under the **info:ofi/** namespace of the "info" URI scheme; and
- ***must*** be network-dereferenceable and point to a document that contains the constraint definition of the *Metadata Format.*

Identification of unregistered *Metadata Formats* is used in *ContextObject Representations* to specify the *Format* by which the *Entities* in the *ContextObjects* are represented.

Table 8: Registry Identifiers for Registered Metadata Formats

"info" URI Namespace	Core Component	Serialization	Constraint Language	Constraint Definition	Registry Identifier
info:ofi/	fmt:	kev:	mtx:	book	info:ofi/fmt:kev:mtx:book
info:ofi/	fmt:	xml:	xsd:	patent	info:ofi/fmt:xml:xsd:patent

Table 8 illustrates the construction of *Registry Identifiers* for two registered *Metadata Formats:*

- *KEV Metadata Format* for items of the type "book", specified by the *Format* triple { KEV, Z39.88-2004 Matrix, book }
- *XML Metadata Format* for items of the type "patent", specified by the *Format* triple {XML, XSD, patent }

(For a list of all *Metadata Formats* in the *initial Registry,* see Table 26 of Appendix C for *KEV Metadata Formats* and Table 28 of Appendix D for *XML Metadata Formats.*)

Example 10: Identification of Unregistered Metadata Formats

```
  rft_val_fmt = http://www.example.net/mtx/cars.html
```

Example 10 shows the identification of an unregistered *Metadata Format* for *By-Value Metadata* of a *Referent* in a *KEV ContextObject Representation.* The file cars.html is a *Constraint Definition.*

10 Transporting ContextObject Representations: Transports [Registry]

A *Transport* is a method by which a *ContextObject Representation* ***may*** be transported over a network. A *Transport* is the combination of a network protocol and a method by which this network protocol transports a *ContextObject Representation.*

Transports ***must*** be registered before use in an *Application.*

Communities ***may*** use *Transports* that are already in the *Registry,* or they ***may*** register additional *Transports* as needed.

Upon registration, a *Transport* is assigned a *Registry Identifier,* formed by concatenating four character strings:

- **info:ofi/**, which represents the namespace under the **info** scheme reserved for *Registry Identifiers*
- **tsp:**, a character string that uniquely identifies a core component of the OpenURL Framework, which for *Transports* ***must*** be **tsp:**
- a character string that is assigned on registration and identifies the network protocol used by the *Transport* followed by a colon character (':')
- a character string that is assigned on registration and identifies the actual *Transport.*

Registry Identifiers of *Transports* are used primarily to support *Registry* management and to identify *Transports* in *Community Profiles.* In typical use, *Registry Identifiers* of *Transports* do not show up in *Representations* of *ContextObjects* or their *Entities.*

Table 9: Registry Identifiers for Transports

"info" URI Namespace	Core Component	Network Protocol	Transport	Registry Identifier
info:ofi/	**tsp:**	**http:**	**openurl-by-val**	**info:ofi/tsp:http:openurl-by-val**
info:ofi/	**tsp:**	**https:**	**openurl-by-ref**	**info:ofi/tsp:https:openurl-by-ref**
info:ofi/	**tsp:**	**http:**	**openurl-inline**	**info:ofi/tsp:http:openurl-inline**

Table 9 illustrates the construction of *Registry Identifiers* for three *Transports.* (See Sections 20 through 22 for all six *Transports* that are in the initial *Registry.*)

11 Defining Applications: Community Profiles [Registry]

When communities create a new *OpenURL Framework Application,* they ***must*** make selections for each of the core components introduced so far. They ***must*** list these selections in a *Community Profile* that specifies the core characteristics of the *Application.*

A *Community Profile* defines the core characteristics of an *Application* as a list of *Registry* entries. This list contains *Registry Identifiers* for:

- One, and only one, *ContextObject Format* upon which the *Application* is built. Because of the nature of *ContextObject Formats,* this implies a selection of:
  - One *Serialization*
  - One *Constraint Language*
  - One or more *Character Encodings*
  - A set of constraints on the type and number of *Entities* that ***may*** be described in a *ContextObject*
  - A set of constraints on the type and number of *Descriptors* that ***may*** be used for the description of *Entities* of a *ContextObject*
  - A constraint on the number of *ContextObjects* that ***may*** be represented in an instance document that conforms to the *ContextObject Format*
- Zero or more registered *Metadata Formats* that ***may*** be used to describe *Entities* with *By-Value* and/or *By-Reference Metadata Descriptors.* Because of the nature of registered *Metadata Formats,* this choice implies a selection of:
  - For registered *Metadata Formats* used in *By-Value Metadata Descriptors:*
    - One *Serialization,* which ***must*** be the *Serialization* used by the *ContextObject Format*
    - One *Constraint Language,* which ***must*** the *Constraint Language* used by the *ContextObject Format*
    - One or more *Character Encodings,* which ***must*** be the same as those used by the *ContextObject Format*
  - For registered *Metadata Formats* used in *By-Reference Metadata Descriptors:*
    - One or more *Serializations,* which ***may*** be the same as the *Serialization* used by the *ContextObject Format*
    - One or more *Constraint Languages,* which ***may*** be the same as the *Constraint Language* used by the *ContextObject Format*
    - One or more *Character Encodings,* which ***should*** be the same as those used by the *ContextObject Format*
- Zero or more *Namespaces* that ***may*** be used to describe *Entities* with an *Identifier Descriptor*
- One or more *Transports* that specify how *ContextObject Representations* in the chosen *ContextObject Format* ***may*** be transported

A *Community Profile* ***must*** be expressed with an *XML Document* that conforms to the XML Schema provided in the *Registry* at <http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:pro>, where it is registered as a *Format.* The Dublin Core metadata [18] of this *Registry* entry are:

info:ofi/fmt:xml:xsd:pro	
dc:title	*XML Format* to represent *Community Profiles*
dc:creator	NISO Committee AX, OpenURL Standard Committee
dc:identifier	info:ofi/fmt:xml:xsd:ctx
dc:identifier	http://www.openurl.info/registry/docs/xsd/info:ofi/fmt:xml:xsd:pro

In addition to the ***mandatory*** expression of a *Community Profile* as an *XML Document,* it is strongly ***recommended*** that communities create a human readable description of their *Application* and its corresponding *Community Profile* for the benefit of implementers.

This Standard does not prescribe or limit *Resolver* responses to service requests. However, a *Resolver* that conforms with a *Community Profile* ***should*** be able to process requests that are valid according to that *Community Profile.* A *Resolver* that conforms with a *Community Profile* ***may*** ignore requests that contain items not specified in the *Community Profile.*

Community Profiles ***must*** be registered before use in an *Application.*

Communities ***may*** use *Community Profiles* already in the *Registry,* or they ***may*** register additional *Community Profiles* as needed.

Upon registration, a *Community Profile* is assigned a *Registry Identifier,* formed by concatenating three character strings:

- **info:ofi/**, which represents the namespace under the **info** scheme reserved for *Registry Identifiers*
- **pro:**, a character string that uniquely identifies a core component of the OpenURL Framework, which for *Community Profiles* ***must*** be **pro:**
- a character string that is assigned on registration and identifies the *Community Profile.*

Registry Identifiers of *Community Profiles* are used primarily to support *Registry* management and to identify *Community Profiles.* In typical use, *Registry Identifiers* of *Community Profiles* do not show up in *ContextObject Representations.*

Table 10: Registry Identifiers for Community Profiles

"info" URI Namespace	Core Component	Name	Registry Identifier
info:ofi/	**pro:**	**sap1**	**info:ofi/pro:sap1**
info:ofi/	**pro:**	**sap2**	**info:ofi/pro:sap2**

Table 10 illustrates the construction of *Registry Identifiers* for the two *Community Profiles* in the initial *Registry.* (See Sections 15 and 19.)

Table 11 excerpts the Level 1 San Antonio *Community Profile* (SAP1), available in the *Registry* at <http://www.openurl.info/registry/docs/pro/info:ofi/pro:sap1>. This excerpt defines some cardinality constraints on the *KEV ContextObject Format,* upon which SAP1 is built. (See Section 13.1.)

Table 11: SAP1 Community Profile, Excerpt

```
<context-object-format>
      <context-object minOccurs="1" maxOccurs="1">
            <referent minOccurs="1" maxOccurs="1">
                  <identifier minOccurs="0" maxOccurs="unbounded"/>
                  <by-value-metadata minOccurs="0" maxOccurs="1"/>
                  <by-reference-metadata minOccurs="0" maxOccurs="1"/>
                  <private-data minOccurs="0" maxOccurs="1"/>
            </referent>
            <referring-entity minOccurs="0" maxOccurs="1">
                  <identifier minOccurs="0" maxOccurs="unbounded"/>
                  <by-value-metadata minOccurs="0" maxOccurs="1"/>
                  <by-reference-metadata minOccurs="0" maxOccurs="1"/>
                  <private-data minOccurs="0" maxOccurs="1"/>
            </referring-entity>
            <requester minOccurs="0" maxOccurs="1">
                  <identifier minOccurs="0" maxOccurs="unbounded"/>
                  <by-value-metadata minOccurs="0" maxOccurs="1"/>
                  <by-reference-metadata minOccurs="0" maxOccurs="1"/>
                  <private-data minOccurs="0" maxOccurs="1"/>
            </requester>
            <service-type minOccurs="0" maxOccurs="1">
                  <identifier minOccurs="0" maxOccurs="unbounded"/>
                  <by-value-metadata minOccurs="0" maxOccurs="1"/>
                  <by-reference-metadata minOccurs="0" maxOccurs="1"/>
                  <private-data minOccurs="0" maxOccurs="1"/>
            </service-type>
            <resolver minOccurs="0" maxOccurs="1">
                  <identifier minOccurs="0" maxOccurs="unbounded"/>
                  <by-value-metadata minOccurs="0" maxOccurs="1"/>
                  <by-reference-metadata minOccurs="0" maxOccurs="1"/>
                  <private-data minOccurs="0" maxOccurs="1"/>
            </resolver>
            <referrer minOccurs="0" maxOccurs="1">
                  <identifier minOccurs="0" maxOccurs="unbounded"/>
                  <by-value-metadata minOccurs="0" maxOccurs="1"/>
                  <by-reference-metadata minOccurs="0" maxOccurs="1"/>
                  <private-data minOccurs="0" maxOccurs="1"/>
            </referrer>
      </context-object>
</context-object-format>
```

The OpenURL Framework for Context-Sensitive Services

Part 2: The KEV ContextObject Format

Part 1 (Sections 5 through 11) defines the core components of the OpenURL Framework: *Namespaces, Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats, Transports,* and *Community Profiles*.

Parts 2, 3, and 4 (Sections 12 through 22) define instances of these core components that illustrate the abstract concepts of Part 1. These instances form the initial content of the *Registry.* Each instance is described, given a *Registry Identifier,* and entered into the *Registry* at <http://www.openurl.info/registry/>. The initial *Registry* launches two *Applications* of the OpenURL Framework Standard intended for the scholarly-information community. The first *Application* provides a migration path from OpenURL 0.1 to the OpenURL Framework Standard. The second *Application* provides a path for future growth by harnessing the full expressive power of XML.

Part 2 defines a *ContextObject Format* inspired by the query string of the HTTP(S) GET request as specified in OpenURL 0.1. Part 3 defines a *ContextObject Format* based on XML. Part 4 defines six *Transports.* Four of these *Transports* are generic and ***may*** be used with any *ContextObject Format.* Two of the *Transports* are developed specifically for the *ContextObject Format* defined in Part 2 to provide a migration path from OpenURL 0.1 to this Standard.

Part 2 (Sections 12 through 15) defines a particular instance of a *ContextObject Format* inspired by the query string of the HTTP(S) GET request as specified in OpenURL 0.1. The *Key/Encoded-Value ContextObject Format* defines how to represent a *ContextObject* as a string of ampersand-delimited Key/Encoded-Value pairs. In the remainder of this Standard, the term Key/Encoded-Value will be abbreviated to KEV.

Section 12 describes and registers the following instances of core components necessary to define the *KEV ContextObject Format:* the *KEV Serialization,* the Z39.88-2004 Matrix *Constraint Language,* and *Constraint Definitions* that define the *KEV ContextObject Format* and illustrate *KEV Metadata Formats.* Sections 13 and 14 apply the *KEV ContextObject Format* to obtain *KEV ContextObject Representations.*

Using the *KEV ContextObject Format,* a *ContextObject* is represented as a URL-encoded form ready for transport by HTTP(S) GET and HTTP(S) POST. The *Inline OpenURL Transports* defined in Section 22 transport a *KEV ContextObject Representation* as the query string of an HTTP(S) GET request or as the message body of an HTTP(S) POST. These *Inline Transports,* the generic *Transports* of Sections 20 and 21, and the *KEV ContextObject Format* form the basis for an easy migration path from OpenURL 0.1 to this Standard. This migration path is formalized in an *Application* defined by the Level 1 San Antonio *Community Profile;* see Section 15 and Appendix C.

12 The KEV ContextObject Format

This Section introduces *Format* triples of the *KEV ContextObject Format* and of the *KEV Metadata Formats* necessary to describe *Entities.* These *Format* triples consist of instances of core components, which are identified, described, and entered into the *Registry* (see Section 6) at <http://www.openurl.info/registry>. The *Format* triples consist of:

- The *KEV Serialization* (Section 12.1)
- The Z39.88-2004 Matrix *Constraint Language* (Section 12.2)
- *Constraint Definitions* expressed in the Z39-88-2004 Matrix *Constraint Language* for the *KEV ContextObject Format* (Sections 12.3.1 and 13) and for the *KEV Metadata Formats* (Sections 13 and 14).

While Sections 12, 13, and 14 introduce, describe, and illustrate these elements, the *Registry* is the authoritative source for their complete specification.

12.1 The KEV Serialization

Registry Identifier **info:ofi/fmt:kev**

The *KEV Serialization* resembles the query component of an HTTP GET request. Often, HTTP GET requests are constructed to transmit information from a user agent to a processing agent. The user agent builds an HTTP URI query component from an HTML form data set on a GET method request and appends this component to an HTTP URI with a question-mark character (‘?’) as a separator. The processing agent residing at this HTTP URI interprets and processes the query component. The syntax of the query component is a list of key/value pairs delimited by ampersand characters (‘&’), such as:

key1=value1&key2=value2

The key/value pairs are delimited by an equals character (‘=’) and concatenated with an ampersand character (‘&’). Keys ***may*** occur multiple times in order to associate multiple values with each key. IETF RFC 2396 [6] reserves the following characters for special use within the query component:

‘;’, ‘/’, ‘?’, ‘:’, ‘@’, ‘&’, ‘=’, ‘+’, ‘$’, and ‘,’.

These characters ***must*** be escaped by URL-encoding.

The key/value syntax is also used on hyperlinks embedded in HTML documents to send parameters to a processing agent. Similarly, on a request that uses the POST method, user agents use the same syntax to include the form data set within an HTTP entity body.

Keys ***must*** be constructed from characters that remain invariant under URL-encoding (also known as safe characters). Values ***may*** be constructed from both safe and unsafe characters and ***must*** be URL-encoded. This explains the name Key/Encoded-Value or KEV for this *Serialization.*

To simplify the descriptions that follow, we include a leading ampersand character (‘&’) with each KEV pair, as in **&key=value**. By doing this, the complete *KEV Serialization* is a simple concatenation of KEV pairs.

12.2 The Z39.88-2004 Matrix Constraint Language

Registry Identifier **info:ofi/fmt:kev:mtx**

The Z39.88-2004 Matrix *Constraint Language* is used to specify constraints for descriptions of resources expressed using the *KEV Serialization.* The Z39.88-2004 Matrix *Constraint Language* is used to define the syntax and semantics of the *KEV ContextObject Format* and *KEV Metadata Formats*.

The Z39.88-2004 Matrix document is expressed in XHTML using a table format to define keys and data types of potential values for the keys. The complete XHTML underlying the construction of Z39.88-2004 Matrices is available in Appendix B and in the *Registry* at <http://www.openurl.info/registry/docs/html/mtx.html>.

Table 12: Structure of the Z39.88-2004 Matrix

Delim	Key	Equals	Value	Min	Max	Description
&	**[** Key **]**	**=**	**<[** Value **]>**	0	1	[** Item definition **]
#	[** ... **]	[** … **]	[** … **]	[** … **]	[** … **]	[** This is a comment row **]

Table 12 shows the structure of a Z39.88-2004 Matrix. It consists of the following columns:

- Delim: the ampersand character ('&') delimiter for rows containing syntax rules or the hash character ('#') for comment rows
- Key: the key being defined
- Equals character ('=')
- Value: the data type for the value associated with the key
- Min: the minimum occurrence allowed for the key; an integer
- Max: the maximum occurrence allowed for the key; an integer or an asterisk character ('*') to denote 'unbounded'
- Description: a full name of the key, a semantic definition of the key, and any further information

Each row of the Z39.88-2004 Matrix with an ampersand character ('&') in the first column describes the construction of a valid KEV pair. Rows of the Z39.88-2004 Matrix that have a hash character ('#') in the first column are comment rows and ***must*** be ignored.

One valid KEV pair is obtained by concatenating table entries from the first four columns of a Z39.88-2004 Matrix row that begins with an ampersand character ('&'). Several valid KEV pairs ***may*** be concatenated to obtain a description of a resource compliant with a Z39.88-2004 *Constraint Definition.* The order in which KEV pairs are concatenated is not important.

In comment rows, replace the character string "[** ... **]" with descriptive text. Descriptive text ***must not*** occur in the Delim column. Usually, only the Description column contains descriptive text.

In the Key column of non-comment rows, the character string "**[** Key **]**" ***must*** be replaced with the name of a valid key.

The Value column of a non-comment row of the Z39.88-2004 Matrix assigns a data type to the key, and **[** Value **]** ***should*** be replaced with one of the following available data types:

- <data>: character string
- <id>: character string for an *Identifier* (Section 5.2.1)

- <fmt-id>: character string for a *Format Identifier* (Sections 8.2 and 9.2)
- <m-key>: character string for a metadata key (Section 14.2)
- <url>: character string for a URL [6]
- <date>: character string of the form [YYYY-MM-DD| YYYY-MM | YYYY], which represents a date formatted according to the W3C DTF profile of ISO 8601 [12]
- <time>: character string of the form [YYYY-MM-DDThh:mm:ssTZD], which represents a complete date plus hours, minutes, and seconds formatted according to the W3C DTF profile of ISO 8601 [12]

In the Description column, [** Item definition **] ***should*** be replaced with descriptive text containing the full name of the key, a semantic definition of the key, and any additional useful information.

12.3 Constraint Definitions in the KEV ContextObject Format

The main *Constraint Definition* associated with the *KEV Serialization* and the Z39.88-2004 Matrix *Constraint Language* is the *KEV ContextObject Format.* This *Format* defines the *Representation* of a *ContextObject* as a concatenation of KEV pairs of the form **&key=value**.

In addition, there are *Constraint Definitions* known as *KEV Metadata Formats* that define the *Representation* of *Entities* of *ContextObjects* as a concatenation of KEV pairs. These *Representations* ***may*** be used for both *By-Value* and/or *By-Reference Metadata Descriptors*.

In the *Registry,* a *Constraint Definition* for a *Format* expressed in the Z39.88-2004 Matrix *Constraint Language* is described by the following metadata:

- **dc:title**: the title of the *Format*
- **dc:creator**: the name of the community that defined the *Format*
- **dc:description**: a brief description of the *Format*
- **dc:identifier**: a locator of the Z39.88-2004 Matrix that defines the *Format*
- **dcterms:created**: the date when the *Format* was created
- **dcterms:modified**: the date when the *Format* was modified

Z39.88-2004 Matrix definitions are primarily intended for human reading. To this end, the XHTML Matrix has an associated style sheet that displays the first four rows of each column in bold type to highlight the syntax embedded in the Matrix. However, machine reading is supported, and each cell of the Matrix has an associated class attribute. The W3C XHTML validator button at the foot of the page ***should*** be used to validate the XHTML Matrix.

A template for the Z39.88-2004 Matrix that ***may*** be used in the creation of *KEV Metadata Formats* is available in Appendix B and in the *Registry* at <http://www.openurl.info/registry/docs/html/mtx.html>.

12.3.1 Z39.88-2004 Matrix Constraint Definition for the KEV ContextObject Format

Registry identifier: **info:ofi/fmt:kev:mtx:ctx**

The Z39.88-2004 Matrix that defines the *KEV ContextObject Format* is available at <http://www.openurl.info/registry/docs/mtx/ info:ofi/fmt:kev:mtx:ctx>. Table 13 is an excerpt that shows the administrative keys (names starting with **ctx**) and the *Referent* keys (names starting with **rft**). Section 13.2 specifies all keys that may occur in a *KEV ContextObject Representation.*

Table 13: Z39.88-2004 Matrix Constraint Definition of KEV ContextObject Format, Excerpt

Delim	Key	Equals	Value	Min	Max	Description
#	**ctx_**			0	1	Administration. As Admin is an optional field in a *ContextObject*, any of the keys with prefix ctx_ ***may*** be present.
&	**ctx_ver**	=	Z39.88-2004	0	1	*ContextObject* version. This has a fixed value.
&	**ctx_enc**	=	<data>	0	1	*ContextObject* encoding. The value for **ctx_enc** specifies the character encoding used in the *ContextObject*. Legitimate values are taken from the IANA list at http://www.iana.org/assignments/character-sets. The values to be used in the *ContextObject* are those listed next to Name or—if available—the values with an indication of 'preferred MIME name' in the IANA list. UTF-8 is the default value, representing UTF-8 encoded Unicode.
&	**ctx_id**	=	<data>	0	1	*ContextObject Identifier.*
&	**ctx_tim**	=	<time>	0	1	*ContextObject* timestamp. YYYY-MM-DD or YYYY-MM-DDThh:mm:ssTZD
#	**rft_**			1	1	*Referent*. As *Referent* is a mandatory *Entity* in a *ContextObject*, at least one of the keys with prefix **rft_** ***must*** be present
&	**rft_id**	=	<id>	0	*	*Referent Identifier*. Multiple instances of **rft_id** do not indicate multiple *Referents*, but rather multiple ways to identify a single *Referent*
&	**rft_val_fmt**	=	<fmt-id>	0	1	*Identifier* of *By-Value Metadata Format* for a *Referent*. *Identifier* of the *Metadata Format* used for the description of the *Referent* through *By-Value Metadata*
#	**rft_val**	=		0	0	Reserved for future use
&	**rft.<m-key>**	=	<data>	0	*	*By-Value Metadata* key for a *Referent*. The **<m-key>** is a key defined in the KEV *Metadata Format* specified by the value of the **rft_val_fmt** key, which ***must*** be present. Use of the **rft.** prefix is mandatory.
&	**rft_ref_fmt**	=	<fmt-id>	0	1	*By-Reference Metadata Format* for a *Referent*. The **rft_ref** key ***must*** also be present.
&	**rft_ref**	=	<url>	0	1	Location of *By-Reference Metadata* for a *Referent*. The **rft_ref_fmt** key ***must*** also be present. The *Resolver* ***should*** retrieve the metadata from the specified location.
&	**rft_dat**	=	<data>	0	1	*Referent Private Data*

12.3.2 Z39.88-2004 Matrix Constraint Definitions for KEV Metadata Formats

The Z39.88-2004 Matrix *Constraint Language* is also used to define *KEV Metadata Formats.* Table 26 in Appendix C contains the list of *KEV Metadata Formats* that are in the initial *Registry.* For each of these *KEV Metadata Formats,* the *Registry* at <http://www.openurl.info/registry> contains a complete and authoritative *Constraint Definition.*

Table 14 is an excerpt of a *Constraint Definition* to describe a class of *Entities* of the type “book”. The complete *Constraint Definition* is available at <http://www.openurl.info/registry/docs/mtx/info:ofi/fmt:kev:mtx:book>.

Keys specified in Z39.88-2004 Matrix *Constraint Definitions* that define *KEV Metadata Formats* ***must*** consist of alphanumeric characters only. They ***must not*** contain underscore characters (‘_’).

Table 14: Z39.88-2004 Matrix Constraint Definition of KEV Metadata Format for "book", Excerpt

Delim	Key	Equals	Value	Min	Max	Description
&	**aulast**	=	<data>	0	1	First author's family name. This ***may*** be more than one word. In many citations, the author's family name is recorded first and is followed by a comma, i.e. Smith, Fred James is recorded as **aulast=smith**.
&	**aufirst**	=	<data>	0	1	First author's given name or names or initials. This data element ***may*** contain multiple words and punctuation, i.e. "Fred F", "Fred James".
&	**auinit**	=	<data>	0	1	First author's first and middle initials.
&	**auinit1**	=	<data>	0	1	First author's first initial.
&	**auinitm**	=	<data>	0	1	First author's middle initial.
&	**ausuffix**	=	<data>	0	1	First author's name suffix. Qualifiers on an author's name such as "Jr." or "III" are entered here. For example, Smith, Fred Jr. is recorded as **ausuffix=jr**.
&	**au**	=	<data>	0	*	This data element contains the full name of a single author; "Smith, Fred M" or "Harry S. Truman", for example.
&	**aucorp**	=	<data>	0	1	Organization or corporation that is the author or creator of the book; "Mellon Foundation", for example.
&	**btitle**	=	<data>	0	1	The title of the book. This can also be expressed as **title**, for compatibility with version 0.1; "moby dick or the white whale", for example.
&	**atitle**	=	<data>	0	1	Chapter title. Chapter title is included if it is a distinct title; "The Push Westward.", for example.
&	**title**	=	<data>	0	1	Book title. Provided for compatibility with version 0.1. Prefer **btitle**.

13 KEV ContextObject Representations

Registry Identifier **info:ofi/fmt:kev:mtx:ctx**

The *KEV Format* represents one, and only one, *ContextObject* as a string of ampersand-delimited pairs, each pair consisting of a key and an associated value that ***must*** be URL-encoded.

The *KEV ContextObject Format* triple consists of:

- The *KEV Serialization* (Section 12.1), recorded in the *Registry* under
  Registry Identifier **info:ofi/fmt:kev**
- The Z39.88-2004 Matrix *Constraint Language* (Section 12.2), recorded in the *Registry* under
  Registry Identifier **info:ofi/fmt:kev:mtx**
- The Z39.88-2004 Matrix *Constraint Definition* (Section 12.3), recorded in the *Registry* under
  Registry Identifier **info:ofi/fmt:kev:mtx:ctx**

Example 11 displays a *KEV ContextObject Representation.* The first part of the example is formatted for readability, and the second part is the actual *KEV ContextObject Representation* with URL-encoded values (see Section 13.4). This example includes administrative keys (beginning with **ctx**), two *Identifier Descriptors* to describe the *Referent* (beginning with **rft**), *Identifier Descriptors* for the *ReferringEntity*, *Requester,* and *Referrer* (**rfe_id**, **req_id**, and **rfr_id**, respectively). (Example 13 will show the use of *By-Value Metadata* in a *KEV ContextObject Representation.*)

Example 11: KEV ContextObject Representation

Formatted for readability:

```
    ctx_ver = Z39.88-2004
  & ctx_enc = info:ofi/enc:UTF-8
  & ctx_id = 456
  & ctx_tim = 2002-03-20T08:55:12Z
  & rft_id = info:doi/10.1126/science.275.5304.1320
  & rft_id = info:pmid/9036860
  & rfe_id = info:doi/10.1006/mthe.2000.0239
  & req_id = mailto:jane.doe@caltech.edu
  & rfr_id = info:sid/elsevier.com:ScienceDirect
```

URL-encoded:

```
ctx_ver=Z39.88-2004&ctx_enc=info%3Aofi%2Fenc%3AUTF-8&ctx_id=456&ctx_tim=200
2-03-20T08%3A55%3A12Z&rft_id=info%3Adoi%2F10.1126%2Fscience.275.5304.1320&r
ft_id=info%3Apmid%2F9036860&rfe_id=info%3Adoi%2F10.1006%2Fmthe.2000.0239&re
q_id=mailto%3Ajane.doe%40caltech.edu&rfr_id=info%3Asid%2Felsevier.com%3ASci
enceDirect
```

13.1 Cardinality Constraints on the KEV ContextObject Format

The *KEV ContextObject Format* restricts the number of *Entities* that ***may*** be present in each *ContextObject,* the number of *Descriptors* that ***may*** be used to describe *Entities,* and the number of *ContextObjects* that may be bundled in a single *KEV Representation.* These constraints are specified and summarized in Table 15 (compare this with the fundamental restrictions of Table 1).

Table 15: KEV ContextObject Format – Cardinality Constraints

Entity	Number	Descriptor			
		Identifier	By-Value Metadata	By-Reference Metadata	Private Data
Referent	1	≥ 0	≤ 1	≤ 1	≤ 1
ReferringEntity	≤ 1	≥ 0	≤ 1	≤ 1	≤ 1
Requester	≤ 1	≥ 0	≤ 1	≤ 1	≤ 1
ServiceType	≤ 1	≥ 0	≤ 1	≤ 1	≤ 1
Resolver	≤ 1	≥ 0	≤ 1	≤ 1	≤ 1
Referrer	≤ 1	≥ 0	≤ 1	≤ 1	≤ 1
ContextObjects	1	N/A	N/A	N/A	N/A

13.2 Keys in the KEV ContextObject Format

The rules for the creation of KEV pairs are:

- The first character of a key ***must*** be alphanumeric. The other characters of keys ***must*** be alphanumeric, the underscore character ('_'), or the dot character ('.').

- A key ***must*** be separated from its associated value by an equals character ('=').
- Values ***must*** be URL-encoded (see Section 14.4).
- The default *Character Encoding* for values is UTF-8 encoded Unicode, but it is possible to declare the use of other *Character Encodings* (see Section 14.3).
- KEV pairs ***must*** be concatenated using the ampersand character ('&') to form a single string.

There are five types of keys in the *KEV ContextObject Format:*

- Keys to identify *Entity Descriptors*
- Keys to identify *Metadata Formats* used for *By-Value Metadata Descriptors*
- Keys to identify *Metadata Formats* used for *By-Reference Metadata Descriptors*
- Keys to specify administrative information about the *ContextObject*
- Metadata keys of a *KEV Metadata Format*

Sections 13.2.1 through 13.2.4 examine the first four types of keys. Section 14.2 examines metadata keys of *KEV Metadata Formats.*

13.2.1 Keys for Entity Descriptors

Keys of *Entity Descriptors* ***must*** contain at least one underscore character ('_'). As shown in Table 16, they are a concatenation of:

- an abbreviated form of the *Entity* name (The column under the heading **Entities** lists the full name of each *Entity* together with its abbreviated form.)
- an underscore character ('_')
- an abbreviated form of the *Descriptor* name (The row under the heading **Descriptors** lists the full name of each *Descriptor* and its abbreviated form.)

For example, the key **rft_id** indicates a *Referent* (**rft**) described by an *Identifier* (**id**).

Table 16: KEV ContextObject Format – Keys for Entity Descriptors

Entities	**Descriptors**			
	Identifier **id**	*By-Value Metadata* **val**	*By-Reference Metadata* **ref**	*Private Data* **dat**
Referent **rft**	**rft_id**	**rft_val_fmt** Metadata keys (13.2.2)	**rft_ref_fmt** **rft_ref**	**rft_dat**
ReferringEntity **rfe**	**rfe_id**	**rfe_val_fmt** Metadata keys (13.2.2)	**rfe_ref_fmt** **rfe_ref**	**rfe_dat**
Requester **req**	**req_id**	**req_val_fmt** Metadata keys (13.2.2)	**req_ref_fmt** **req_ref**	**req_dat**
ServiceType **svc**	**svc_id**	**svc_val_fmt** Metadata keys (13.2.2)	**svc_ref_fmt** **svc_ref**	**svc_dat**
Resolver **res**	**res_id**	**res_val_fmt** Metadata keys (13.2.2)	**res_ref_fmt** **res_ref**	**res_dat**
Referrer **rfr**	**rfr_id**	**rfr_val_fmt** Metadata keys (13.2.2)	**rfr_ref_fmt** **rfr_ref**	**rfr_dat**

13.2.2 Keys for By-Value Metadata Descriptors

Metadata keys ***must*** consist of alphanumeric characters only. Metadata keys ***must not*** contain underscore characters ('_').

When used in *By-Value Metadata,* metadata keys ***must*** be preceded by an *Entity* prefix (the abbreviated *Entity* name listed in the first column of Table 16) followed the period character ('**.**').

For example, the prefix **rfe.** and metadata key **au** combined as **rfe.au** denotes the author of a *ReferringEntity,* while **rft.au** would refer to the author of the *Referent*.

13.2.3 Keys for By-Reference Metadata Descriptors

When used in *By-Reference Metadata,* metadata keys ***must not*** be preceded by any prefix.

It is anticipated that *By-Reference Metadata* are constructed well before the *ContextObject* is formed (presumably as part of a database). At that time, the item described by this metadata is not yet a particular *Entity:* it could be a *Referent* in one *ContextObject* and a *ReferringEntity* in another *ContextObject*.

13.2.4 Keys for Administrative Data

Keys for administrative data about the *ContextObject* are composed of the prefix **ctx** for *ContextObject,* the underscore character ('_'), and an abbreviated suffix. Table 17 gives the keys and their cardinality constraints.

Table 17: KEV ContextObject Format – Administration Key Prefix and Suffixes

Key	Number	Definition
ctx_ver	≤ 1	Version of OpenURL Framework Standard. Fixed value of Z39.88-2004
ctx_enc	≤ 1	*Character Encoding, Registry Identifier* of the form **info:ofi/enc:_** (Section 13.3)
ctx_id	≤ 1	Identifier of *ContextObject*
ctx_tim	≤ 1	ISO 8601datetime specifying the time of creation of the *ContextObject*

Note: The **ctx_id** key ***may*** have limited use for *KEV ContextObject Representations.* It is included for consistency with the *XML ContextObject Format* (see Part 3) and possibly other *ContextObject Formats. XML ContextObject Representations* are more likely to be stored in databases, in which case a *ContextObject* identifier might be helpful for fast retrieval.

13.3 Character Encoding in the KEV ContextObject Format

UTF-8 encoded Unicode is the default *Character Encoding* of the *KEV ContextObject Format.* The use of a different *Character Encoding* ***must*** be specified in the **ctx_enc** KEV pair:

- The default value associated with the **ctx_enc** key is **info:ofi/enc:UTF-8**, the *Registry Identifier* of UTF-8 encoded Unicode. This value specifies the use of Unicode as the character set and UTF-8 as the character encoding of that character set throughout the *KEV ContextObject Representation.* When the *Character Encoding* is UTF-8 encoded Unicode, the **ctx_enc** KEV pair is ***optional***.
- Values associated with the **ctx_enc** key ***must*** be *Registry Identifiers* of *Character Encodings* taken from the *Registry.* Registered character sets ***must*** be from the Internet Assigned Naming Authority (IANA) List of Registered Character Sets [7]. Upon registration, a unique *Registry Identifier* of the form **info:ofi/enc:*name*** is assigned to the character set. In **info:ofi/enc:*name***, the character string ***name*** is taken from the IANA list, as defined in Section 8.1.

The character set and character encoding for all characters used in a *KEV ContextObject Representation* ***must*** follow the corresponding specification shown in the IANA list.

The *Character Encodings* that are initially registered are listed in Table 26 of Appendix C.

By-Reference Metadata ***must*** use Unicode as the character set and UTF-8 as the character encoding, unless the *By-Reference Metadata* description explicitly declares otherwise.

13.4 URL-Encoding in the KEV ContextObject Format

Values of KEV pairs ***must*** be URL-encoded to ensure that the *KEV ContextObject Representation* is ready to be transported over the HTTP(S) protocol. URL-encoding eliminates confusion that could occur when special characters, such as equals character ('=') and ampersand character ('&'), are used within values of KEV pairs.

Rules for URL-encoding values are:

- The alphanumeric characters (letters and digits), the period character ('.'), the hyphen character ('-'), the asterisk character ('*'), and the underscore character ('_') remain the same.
- The space character (' ') is converted into a plus sign ('+') or into the character string "%20".
- For all other characters, each byte of the character is converted into a three-character string "%XY" where "XY" is the two-digit hexadecimal representation of the byte.

14 Entity Descriptors in the KEV ContextObject Format

A *Descriptor* specifies information about an *Entity.* There are four types of *Descriptors* that ***may*** be used in the *KEV ContextObject Format: Identifier, By-Value Metadata, By-Reference Metadata,* and *Private Data.*

14.1 Identifier Descriptors

An *Identifier Descriptor* specifies an *Entity* by means of a Uniform Resource Identifier (URI). This URI ***may*** be associated with the *Entity* itself or with metadata for the *Entity*. As described in Section 13.2.1, keys to identify *Identifier Descriptors* in the *KEV ContextObject Format* consist of two parts separated by an underscore character ('_'). The first part identifies the *Entity,* and the second part is the character string **id**, which specifies that the type of *Descriptor* is an *Identifier Descriptor.* For example, the key **rft_id** denotes an *Identifier Descriptor* for a *Referent.*

Example 12: Identifier Descriptors in a KEV ContextObject Representation

Formatted for readability:

```
  & rft_id = info:doi/10.1126/science.275.5304.1320
  & rft_id = info:pmid/9036860
  & rfe_id = info:doi/10.1006/mthe.2000.0239
  & req_id = mailto:jane.doe@caltech.edu
  & rfr_id = info:sid/elsevier.com:ScienceDirect
  & res_id = http://links.caltech.edu/menu
```

URL-encoded:

```
&rft_id=info%3Adoi%2F10.1126%2Fscience.275.5304.1320&rft_id=info%3Apmid%2F
9036860&rfe_id=info%3Adoi%2F10.1006%2Fmthe.2000.0239&req_id=mailto%3Ajane.
doe%40caltech.edu&rfr_id=info%3Asid%2Felsevier.com%3AScienceDirect&res_id=
http%3A%2F%2Flinks.caltech.edu%2Fmenu
```

Example 12 shows several *Identifier Descriptors* as they would occur in a *KEV ContextObject Representation.*

14.2 By-Value and By-Reference Metadata Descriptors

A *Metadata Format* provides a concrete set of descriptive elements for the purpose of representing an *Entity.* For compatibility, *Metadata Formats* and the *ContextObject Format* ***must*** be based on the same *Serialization* and *Constraint Language.* This compatibility rule is waived for *By-Reference Metadata,* provided the *Metadata Format* is registered (see Section 14.2.1).

Metadata Formats used in the OpenURL Framework ***may*** be registered. Unregistered *Metadata Formats* ***must*** meet the requirements described in Section 9.2.

14.2.1 Rules Guiding By-Value and By-Reference Metadata Descriptors

The general rules for *Metadata Formats* are given in Section 9.2. This Section gives the rules for creating *By-Value Metadata* and *By-Reference Metadata* in the *KEV ContextObject Format.* The *KEV ContextObject Format* accommodates both registered and unregistered *Metadata Formats.*

- Registered *Metadata Formats*
  - Registered *Metadata Formats* ***must*** be identified by means of the *Registry Identifier* of the *Metadata Format.* The *Registry* maintains a one-to-one correspondence between the definition of a *Metadata Format* and its *Registry Identifier.* The identification of the *Metadata Format* ***must*** be provided as the value of a key with the suffix **_fmt**.
  - The corresponding *By-Value Metadata Descriptor* ***must*** use the *KEV Serialization* and ***must*** be valid according to a Z39.88-2004 Matrix. This Matrix ***must*** be in the *Registry* and correspond uniquely with the *Registry Identifier* used to identify the *Metadata Format.* The *Registry Identifier* of the *Metadata Format* ***must*** be of the form: **info:ofi/fmt:kev:mtx:format_name**. Note that validity refers to the string of KEV pairs after removal of the **rft.**, **rfe.**, **rfr.**, **req.**, **res.**, and **svc.** prefixes. (See Section 13.2.2.)
  - The corresponding *By-Reference Metadata Descriptor* ***must*** be an instance document that conforms to the *Metadata Format* identified by the *Registry Identifier.* Because the *Metadata Format* is registered, the *By-Reference Metadata Descriptor* ***may*** use any registered *Serialization,* and the *Metadata Format* to which it conforms ***may*** use any registered *Constraint Language.* The *By-Reference Metadata Descriptor* is not limited to the *KEV Serialization* or the Z39.88-2004 Matrix *Constraint Language.*
- Unregistered *Metadata Formats*
  - Unregistered *Metadata Formats* ***must*** be identified by means of a URL that specifies the network location of the Z39.88-2004 Matrix that defines the *KEV Metadata Format.* The identification of the *Metadata Format* ***must*** be provided as the value of a key with the suffix **_fmt**. For example, a *Metadata Format* could be identified as: **http://www.example.net/x-service.html**.
  - The corresponding *By-Value Metadata* or *By-Reference Metadata Descriptor* ***must*** use the *KEV Serialization:* it ***must*** be a string of ampersand-delimited KEV pairs that is valid according to the Z39.88-2004 Matrix at the network location specified by the aforementioned URL. Note that validity refers to the string of KEV pairs after removal of the **rft.**, **rfe.**, **rfr.**, **req.**, **res.**, and **svc.** prefixes. (See Section 13.2.2.)

14.2.2 By-Value Metadata Descriptors

A *KEV By-Value Metadata Descriptor* consists of:

- A KEV pair that specifies the URI of a *Metadata Format* as the value associated with a key of the form ***_val_fmt**. (The ***** stands for the abbreviated form of an *Entity* name.) This *Metadata Format* ***must*** be defined by means of a Z39.88-2004 Matrix *Constraint Definition.*
- A set of KEV pairs in which values are assigned to metadata keys. These keys ***must*** be valid according to the specified *Metadata Format.*

Example 13: By-Value Metadata Descriptor in a KEV ContextObject Representation

Formatted for readability:

```
  & rft_val_fmt = info:ofi/fmt:kev:mtx:journal
  & rft.atitle = Isolation of a common receptor for coxsackie B
  & rft.jtitle = Science
  & rft.aulast = Bergelson
  & rft.auinit = J
  & rft.date = 1997
  & rft.volume = 275
  & rft.spage = 1320
```

URL-encoded:

```
&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.atitle=Isolation%2
0of%20a%20common%20receptor%20for%20coxsackie%20B&rft.jtitle=Science&rft.a
ulast=Bergelson&rft.auinit=J&rft.date=1997&rft.volume=275&rft.spage=1320
```

Example 13 shows a *By-Value Metadata Descriptor* for a *Referent.* In this example, the *Referent* is an article in a journal.

- The KEV pair **rft_val_fmt = info:ofi/fmt:kev:mtx:journal** specifies the *Metadata Format.* The key name indicates that this KEV pair specifies a *By-Value Metadata Format* used to describe a *Referent.* The value identifies the Z39.88-2004 Matrix *Constraint Definition* of the *Metadata Format.* Following the usage rules of the *Registry* (see Section 6.3), the *Constraint Definition* is available at <http://openurl.info/registry/docs/info:ofi/fmt:kev:mtx:journal>.
- KEV pairs that represent the *Referent* in this *Metadata Format* have keys with an **rft.** prefix. The character strings that follow the **rtf.** prefix (**atitle** and **jtitle**, for example) are the key names defined in the *Constraint Definition.*

14.2.3 By-Reference Metadata Descriptors

A *KEV By-Reference Metadata Descriptor* consists of:

- A KEV pair that specifies the URI of a *Metadata Format* as the value associated with a key of the form ***_ref_fmt**. (The ***** stands for the abbreviated form of an *Entity* name.)
- A KEV pair that specifies the URL of a *By-Reference Metadata* description as the value associated with a key of the form ***_ref**.

Example 14: By-Reference Metadata Descriptor as a Property List

Formatted for readability:

```
  & req_ref_fmt = http://lib.caltech.edu/fmt/ldap-mtx.html
  & req_ref = http://ldap.caltech.edu/janed/record.txt
```

URL-encoded:
```
&req_ref_fmt=http%3A%2F%2Flib.caltech.edu%2Ffmt%2Fldap-mtx.html&req_ref=ht
tp%3A%2F%2Fldap.caltech.edu%2Fjaned%2Frecord.txt
```

Example 14 shows a *By-Reference Metadata Descriptor* for a *Requester.* In this example, the *Requester* is a student at Caltech, identified by her LDAP record.

- The KEV pair **req_ref_fmt = http://lib.caltech.edu/fmt/ldap-mtx.html** specifies the *Metadata Format.* The key name indicates that this KEV pair specifies a *By-Reference Metadata Format* used to describe a *Requester.* The value identifies the Z39.88-2004 Matrix *Constraint Definition* of the *Metadata Format.* Since this *Metadata Format* is not registered, its *Constraint Definition* ***must*** be a Z39.88-2004 Matrix (see Sections 9.2 and 14.2.1).
- The KEV pair **req_ref = http://ldap.caltech.edu/janed/record.txt** specifies the location of the *Descriptor* of the *Requester.* The keys used in this *Descriptor* are defined in the *Constraint Definition,* and they ***must not*** be prefixed.

14.3 Private Data Descriptors

A *Private Data Descriptor* specifies information about the *Entity* using a method not defined in this Standard. This Standard does not provide any global mechanisms to interpret *Private Data.* Instead, it is assumed that the *Resolver* and the *Referrer* have a common understanding, based on a tacit or explicit bilateral agreement. To make it possible for the *Resolver* to interpret *Private Data,* a *ContextObject* that contains a *Private Data Descriptor* ***must*** identify the *Referrer* that created it.

As described in Section 13.2.1, keys to identify *Private Data Descriptors* in the *KEV ContextObject Format* consist of two parts separated by an underscore character ('_'). The first part identifies the *Entity;* the second part is the character string **dat** to specify that the *Descriptor* is a *Private Data Descriptor.* For example, the key **rfe_dat** is associated with a *Private Data Descriptor* for a *ReferringEntity.*

Example 15: Private Data Descriptor in a KEV ContextObject Representation

Formatted for readability:
```
  & rfe_dat = cites/8///citedby/12
  & rfr_id = info:sid/elsevier.com:ScienceDirect
```
URL-encoded:
```
&rfe_dat=cites%2F8%2F%2F%2Fcitedby%2F12&rfr_id=info%3Asid%2Felsevier.com%3
AScienceDirect
```

Example 15 shows a *Private Data Descriptor* for a *ReferringEntity.*

- The KEV pair **rfe_dat = cites/8///citedby/12** is *Private Data* provided about the *ReferringEntity.* In this example, the *ReferringEntity* is a journal article identified by a proprietary identifier.
- The KEV pair **rfr_id = info:sid/elsevier.com:ScienceDirect** is an *Identifier Descriptor* of the *Referrer,* which might help the *Resolver* to interpret the *Private Data.*

14.4 Example of a KEV ContextObject Representation

Example 16 represents a complete *ContextObject* and combines several of the previous examples.

The initial four KEV pairs convey administrative information: the version of the *ContextObject Format*, the *Character Encoding,* the identifier of the *ContextObject,* and the time at which the *ContextObject Representation* was created.

The next nine KEV pairs form a *By-Value Metadata Descriptor* of the *Referent.* The **rft_val_fmt** KEV pair defines the *Metadata Format* by assigning the *Registry Identifier* of a Z39.88-2004 Matrix *Constraint Definition* (**info:ofi/fmt:kev:mtx:journal**) to the **rft_val_fmt** key. This is followed by KEV pairs whose keys consist of an **rft.** prefix and key names, such as **atitle** and **jtitle**, that are defined in the *Constraint Definition.* These KEV pairs are the *By-Value Metadata.*

The ten KEV pairs that follow form a *By-Value Metadata Descriptor* of the *ReferringEntity.* The structure of this part is identical to that used for the *Referent.*

The final two KEV pairs form a *By-Reference Metadata Descriptor* of the *Requester.* The **req_ref_fmt** KEV pair defines the *Metadata Format* by assigning the URL of a Z39.88-2004 Matrix *Constraint Definition* that defines the *Metadata Format* to the **req_ref_fmt** key. The **req_ref** KEV pair specifies the URL of the actual metadata.

Example 16: KEV ContextObject Representation

Formatted for readability:
```
    ctx_ver = Z39.88-2004
  & ctx_enc = info:ofi/enc:UTF-8
  & ctx_id = 345871
  & ctx_tim = 2002-03-20T08:55:12Z
  & rft_val_fmt = info:ofi/fmt:kev:mtx:journal
  & rft.atitle = Isolation of a common receptor for coxsackie B
  & rft.jtitle = Science
  & rft.aulast = Bergelson
  & rft.auinit = J
  & rft.date = 1997
  & rft.volume = 275
  & rft.spage = 1320
  & rft.epage = 1323
  & rfe_val_fmt = info:ofi/fmt:kev:mtx:journal
  & rfe.atitle = p27-p16 Chimera: A Superior Antiproliferative
  & rfe.jtitle = Molecular Therapy
  & rfe.aulast = McArthur
  & rfe.aufirst = James
  & rfe.date = 2001
  & rfe.volume = 3
  & rfe.issue = 1
  & rfe.spage = 8
  & rfe.epage = 13
  & req_ref_fmt = http://lib.caltech.edu/fmt/ldap-mtx.html
  & req_ref = http://ldap.caltech.edu/janed/record.txt
```

URL-encoded:

```
ctx_ver=Z39.88-2004&ctx_enc=info%3Aofi%2Fenc%3AUTF-8&ctx_id=345871&ctx_tim
=2002-03-20T08%3A55%3A12Z&rft_val_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajourn
al&rft.atitle=Isolation%20of%20a%20common%20receptor%20for%20coxsackie%20B
rft.jtitle=Science&rft.aulast=Bergelson&rft.auinit=J&rft.date=1997&rft.vol
ume=275&rft.spage=1320&rft.epage=1323&rfe_val_fmt=info%3Aofi%2Ffmt%3Akev%3
Amtx%3Ajournal&rfe.atitle=p27-p16%20Chimera%3A%20A%20Superior%20Antiprolif
erative&rfe.jtitle=Molecular%20Therapy&rfe.aulast=McArthur&rfe.aufirst=Jam
es&rfe.date=2001&rfe.volume=3&rfe.issue=1&rfe.spage=8&rfe.epage=13&req_ref
_fmt=http%3A%2F%2Flib.caltech.edu%2Ffmt%2Fldap-mtx.html&req_ref=http%3A%2F
%2Fldap.caltech.edu%2Fjaned%2Frecord.txt
```

15 KEV-Based Community Profiles

A *Community Profile* lists a selection of *Registry* entries. This selection specifies the *ContextObject Format,* the *Metadata Format(s),* and the *Transport(s)* that form the core properties of an OpenURL *Application.* Further information on the creation of *Community Profiles* is found in Section 11.

A *Resolver* that conforms to the *KEV ContextObject Format* ***must*** process all items that conform to *Registry* entries specified in a *Community Profile* using the *KEV ContextObject Format.* Communities ***may*** define additional conformance rules in their *Community Profiles.*

Appendix C describes the Level 1 San Antonio *Community Profile,* which is an example of a *Community Profile* based on the *KEV ContextObject Format.* This *Community Profile* was developed by NISO Committee AX for the scholarly-information community. It deploys an *Application* that is similar to, but is more expressive than, the OpenURL 0.1 specification. In the remainder of this Standard, this *Community Profile* will be referred to as the SAP1 *Community Profile.* Its *Registry Identifier* is **info:ofi/pro:sap1-2004**.

Other communities are encouraged to use the KEV *ContextObject Format* to deploy their own OpenURL *Applications.* As specified in Section 11, each *Application* ***must*** be defined in a *Community Profile.* A straightforward way to deploy KEV-based *Applications* is to modify the SAP1 *Community Profile* to the needs of new communities.

The OpenURL Framework for Context-Sensitive Services

Part 3: The XML ContextObject Format

Part 1 (Sections 5 through 11) defines the core components of the OpenURL Framework: *Namespaces, Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats, Transports,* and *Community Profiles*.

Parts 2, 3, and 4 (Sections 12 through 22) define instances of these core components that illustrate the abstract concepts of Part 1. These instances form the initial content of the *Registry.* Each instance is described, given a *Registry Identifier,* and entered into the *Registry* at <http://www.openurl.info/registry/>. The initial *Registry* launches two *Applications* of the OpenURL Framework Standard intended for the scholarly-information community. The first *Application* provides a migration path from OpenURL 0.1 to the OpenURL Framework Standard. The second *Application* provides a path for future growth by harnessing the full expressive power of XML.

Part 2 defines a *ContextObject Format* inspired by the query string of the HTTP(S) GET request as specified in OpenURL 0.1. Part 3 defines a *ContextObject Format* based on XML. Part 4 defines six *Transports.* Four of these *Transports* are generic and ***may*** be used with any *ContextObject Format.* Two of the *Transports* are developed specifically for the *ContextObject Format* defined in Part 2 to provide a migration path from OpenURL 0.1 to this Standard.

Part 3 (Sections 16 through 19) defines a *ContextObject Format* based on XML (eXtensible Markup Language). XML is a markup language from the World Wide Web Consortium [1]. Like HTML, it uses tags to describe text and data in documents, but XML provides the capability of creating customized tags. *XML Documents* are widely used in the exchange of structured text and data between computer applications. With the *XML ContextObject Format, ContextObjects* can convey greater detail, which *Resolvers* can use to provide more appropriate services.

Section 16 describes and registers the following instances of core components necessary to define the *XML ContextObject Format:* the *XML Serialization,* the XML Schema *Constraint Language,* and *Constraint Definitions* that define the *XML ContextObject Format* and illustrate *XML Metadata Formats.* Sections 17 and 18 apply the *XML ContextObject Format* to obtain *XML ContextObject Representations.*

Using the *XML ContextObject Format,* one or more *ContextObjects* are represented as an *XML Document.* This *XML Document* may be transported by any of the *Transports* defined in Sections 20 and 21. These *Transports* and the *XML ContextObject Format* form the basis for a new *Application* that makes available the full expressive power of the XML syntax and structure to providers of context-sensitive services for the scholarly-information community. This *Application* is defined by the Level 2 San Antonio *Community Profile;* see Section 19 and Appendix D.

16 The XML ContextObject Format

This Section introduces the *Format* triples of the *XML ContextObject Format* and the *XML Metadata Formats* necessary to describe *Entities.* The *Format* triples consist of:

- The *XML Serialization* (Section 16.1)
- The XML Schema *Constraint Language* (Section 16.2)
- *Constraint Definitions* expressed in XML Schema document instances that define the structure of the *XML ContextObject Format* (Sections 16.3.1 and 17) and of *XML Metadata Formats* (Sections 16.3.2 and 18).

While Sections 16, 17, and 18 introduce, describe, and illustrate these elements, the *Registry* is the authoritative source for their complete specification.

16.1 The XML Serialization

Registry Identifier **info:ofi/fmt:xml**

The *XML Serialization* is XML as defined in the Extensible Markup Language (XML) 1.0 (Third Edition) [1].

16.2 XML Schema as a Constraint Language

Registry Identifier **info:ofi/fmt:xml:xsd**

This Standard makes use of XML Schema [3] [4] to specify constraints and structures for resource descriptions expressed in the XML *Serialization.* In the *XML Serialization,* descriptions are expressed as *XML Documents* that conform to a registered XML Schema.

16.3 Constraint Definitions in the XML ContextObject Format

The main *Constraint Definition* associated with the *XML Serialization* and the XML Schema *Constraint Language* is the *XML ContextObject Format.* This *Format* defines the *Representation* of a *ContextObject* as an *XML Document.*

In addition, there are *Constraint Definitions* known as *XML Metadata Formats* that define the *Representation* of *Entities* of *ContextObjects* as *XML Documents* or *XML Document* fragments. These *Representations* ***may*** be used for both *By-Value* and/or *By-Reference Metadata Descriptors.*

In the *Registry,* a *Constraint Definition* for a *Format* expressed in the XML Schema *Constraint Language* is described by the following metadata:

- **dc:title**: the title of the *Format*
- **dc:creator**: the name of the community that defined the *Format*
- **dc:description**: a brief description of the *Format*
- **dc:identifier**: a locator of the XML Schema that defines the *Format*
- **dcterms:created**: the date when the *Format* was created
- **dcterms:modified**: the date when the *Format* was modified

XML Schemas are primarily intended for use by XML parsing and validation software.

16.3.1 XML Schema Constraint Definition for the XML ContextObject Format

Registry identifier: **info:ofi/fmt:xml:xsd:ctx**

Table 18 is the XML Schema for *ContextObjects.* This XML Schema *Constraint Definition,* also available in the *Registry* at < http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:ctx>, allows for the definition of multiple *ContextObjects* in one *XML Document.*

Table 18: XML Schema Constraint Definition of XML ContextObject Format

```
<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="info:ofi/fmt:xml:xsd:ctx"
xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:ctx="info:ofi/fmt:xml:xsd:ctx-2004"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
elementFormDefault="qualified" attributeFormDefault="unqualified"
xsi:schemaLocation="http://www.w3.org/2001/XMLSchema
http://www.w3.org/2001/XMLSchema.xsd">
      <annotation>
            <documentation>XML Schema defining XML ContextObject
Format. Validated with XML Spy v.5.3 on September 27th 2003. This XML
Schema
is available at http://www.openurl.info/registry/docs/info:ofi/fmt:xml:
xsd:ctx</documentation>
            <appinfo xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/">
                  <dc:title>XML ContextObject Format </dc:title>
                  <dc:creator>NISO Committee AX, OpenURL Standard
Committee</dc:creator>
                  <dc:creator>Herbert Van de Sompel</dc:creator>
                  <dc:description>This XML Schema defines a format to
express one or more ContextObjects as an XML document.</dc:description>
                  <dc:identifier>info:ofi/fmt:xml:xsd:ctx-
2004</dc:identifier>

      <dc:identifier>http://www.openurl.info/registry/docs/info:ofi/fmt
:xml:xsd:ctx </dc:identifier>
                  <dcterms:created>2004-01-01</dcterms:created>
            </appinfo>
      </annotation>
      <element name="context-objects">
            <annotation>
                  <documentation>The 'context-objects' element is a
wrapper holding one or more autonomous XML
ContextObjects.</documentation>
            </annotation>
            <complexType>
                  <complexContent>
                        <extension base="ctx:context-objects-type"/>
                  </complexContent>
            </complexType>
      </element>
      <complexType name="context-objects-type">
            <annotation>
                  <documentation>The 'context-objects' element is a
wrapper holding one or more autonomous ContextObjects.</documentation>
                  <documentation>The 'context-objects' element has an
optional administrative child element  to hold Community-specific
administrative data. The name of that element is
'administration'.</documentation>
            </annotation>
            <sequence>
                  <element name="administration"
type="ctx:administration-type" minOccurs="0"/>
                  <element ref="ctx:context-object"
maxOccurs="unbounded"/>
            </sequence>
      </complexType>
      <element name="context-object">
            <annotation>
                  <documentation>The ContextObject is an information
construct to represent an Entity that is referenced in a networked
environment (the Referent) along with Entities that constitute the
context in which the Referent is referenced. In the ContextObject, the
Entities that describe the context are: the ReferringEntity, the
Requester, the Resolver, the ServiceType, the Referrer. The
ContextObject is represented by the 'context-object' element in this
XML ContextObject Format</documentation>
            </annotation>
            <complexType>
                  <complexContent>
                        <extension base="ctx:context-object-type"/>
                  </complexContent>
            </complexType>
      </element>
      <complexType name="context-object-type">
            <annotation>
                  <documentation>The ContextObject represented using
the XML ContextObject Format contains descriptions of the following
Entities: (1) exactly one Referent, (2) zero or one ReferringEntity,
(3) zero or one Requester, (4) zero or more ServiceTypes, (5) zero or
more Resolvers, and (6) zero or one Referrer. In the XML ContextObject
Format, these Entities are represented by the elements 'referent',
'referring-entity', 'requester', 'service-type', 'resolver', and
'referrer', respectively.</documentation>
                  <documentation>Each ContextObject has the following
optional administrative attributes: (1) 'version' attribute - version
of the ContextObject - fixed value Z39.88-2004 (optional), (2)
'identifier' attribute - identifier of the ContextObject (optional),
and  (3) 'timestamp' attribute - date/time of creation of the
ContextObject (optional).</documentation>
                  <documentation>The 'context-object' element has an
optional administrative child element  to hold Community-specific
```

```
administrative data. The name of that element is
'administration'.</documentation>
            </annotation>
            <sequence>
                  <element name="administration"
type="ctx:administration-type" minOccurs="0"/>
                  <element name="referent" type="ctx:descriptor-type"/>
                  <element name="referring-entity"
type="ctx:descriptor-type" minOccurs="0"/>
                  <element name="requester" type="ctx:descriptor-type"
minOccurs="0"/>
                  <element name="service-type" type="ctx:descriptor-
type" minOccurs="0" maxOccurs="unbounded"/>
                  <element name="resolver" type="ctx:descriptor-type"
minOccurs="0" maxOccurs="unbounded"/>
                  <element name="referrer" type="ctx:descriptor-type"
minOccurs="0"/>
            </sequence>
            <attribute name="version" use="optional" fixed="Z39.88-
2004"/>
            <attribute name="identifier" type="string" use="optional"/>
            <attribute name="timestamp" type="ctx:utc-datetime-type"
use="optional"/>
      </complexType>
      <complexType name="descriptor-type">
            <annotation>
                  <documentation>In the XML ContextObject Format, each
Entity of the ContextObject can be described by means of the following
Descriptors: (1) zero or more Identifier Descriptors, (2) zero or more
By-Value Metadata Descriptors, (3) zero or more By-Reference Metadata
Descriptors, and (4) zero or more Private Data Descriptors. In the XML
ContextObject Format, these Descriptors are contained in the elements
'identifier', 'metadata-by-val', 'metadata-by-ref', and 'private-data',
respectively.</documentation>
            </annotation>
            <sequence>
                  <element name="identifier" type="ctx:identifier-type"
minOccurs="0" maxOccurs="unbounded"/>
                  <element name="metadata-by-val" type="ctx:metadata-
by-val-type" minOccurs="0" maxOccurs="unbounded"/>
                  <element name="metadata-by-ref" type="ctx:metadata-
by-ref-type" minOccurs="0" maxOccurs="unbounded"/>
                  <element name="private-data" type="ctx:private-data-
type" minOccurs="0" maxOccurs="unbounded"/>
            </sequence>
      </complexType>
      <simpleType name="identifier-type">
            <annotation>
                  <documentation>Identifiers in the OpenURL Framework
are URIs</documentation>
```

```
            </annotation>
            <restriction base="anyURI"/>
      </simpleType>
      <complexType name="metadata-by-val-type">
            <annotation>
                  <documentation>By-Value Metadata is provided through
an XML description embedded in the ContextObject.</documentation>
                  <documentation>The By-Value Metadata is provided as
the combination of (1) a 'format' element, which identifies the
Metadata Format of the By-Value Metadata, and (2) a 'metadata' element
in which the metadata corresponding to the identified Metadata Format
is contained.</documentation>
            </annotation>
            <sequence>
                  <element name="format" type="ctx:metadata-identifier-
type"/>
                  <element name="metadata" type="ctx:metadata-type"/>
            </sequence>
      </complexType>
      <complexType name="metadata-type">
            <sequence>
                  <any namespace="##other" processContents="lax"/>
            </sequence>
      </complexType>
      <complexType name="metadata-by-ref-type">
            <annotation>
                  <documentation>By-Reference Metadata is provided by
means of the network-location of a document that contains the
metadata.</documentation>
                  <documentation>By-Reference Metadata is provided as
the combination of (1) a 'format' element, which identifies the
Metadata Format of the By-Reference Metadata, and (2) a 'location'
element that specifies the network-location of the By-Reference
Metadata</documentation>
            </annotation>
            <sequence>
                  <element name="format" type="ctx:metadata-identifier-
type"/>
                  <element name="location" type="ctx:network-location-
type"/>
            </sequence>
      </complexType>
      <complexType name="private-data-type">
            <annotation>
                  <documentation>Private Data is provided through an
XML description that declares its XML Namespace URI and
schemaLocation.</documentation>
            </annotation>
            <sequence>
```

```
                  <any namespace="##other" processContents="lax"/>
            </sequence>
      </complexType>
      <simpleType name="metadata-identifier-type">
            <annotation>
                  <documentation>Metadata Formats in the OpenURL
Framework are identified by means of URIs. Registered Metadata Formats
have a URI in the info:ofi/fmt: namespace, whereas Unregistered
Metadata Formats have a URI in another URI namespace. Both URIs are
dereferencable to a document defining the Metadata
Format</documentation>
            </annotation>
            <restriction base="anyURI"/>
      </simpleType>
      <simpleType name="network-location-type">
            <annotation>
                  <documentation>The content of the network-location
element is a URL specifying the network location of the By-Reference
Metadata Description</documentation>
            </annotation>
            <restriction base="anyURI"/>
      </simpleType>
      <complexType name="administration-type">
            <annotation>
                  <documentation>Administrative information can be
attached to the 'context-objects' and/or the 'context-object' element.
Its content can be defined by communities of implementers.
                  </documentation>
            </annotation>
            <sequence>
                  <any namespace="##other" processContents="lax"/>
            </sequence>
      </complexType>
      <simpleType name="utc-datetime-type">
            <annotation>
                  <documentation>Valid values follow the ISO 8601 YYYY-
MM-DD or YYYY-MM-DDTHH:MM:SSZ notation.</documentation>
            </annotation>
            <union memberTypes="date dateTime"/>
      </simpleType>
</schema>
```

16.3.2 XML Schema Constraint Definitions for XML Metadata Formats

The XML Schema *Constraint Language* is also used to define *XML Metadata Formats.* Table 28 in Appendix D contains the list of *XML Metadata Formats* that are in the initial *Registry.* For each of these *XML Metadata Formats,* the *Registry* at <http://www.openurl.info/registry> contains a complete and authoritative *Constraint Definition.*

Table 19 is a *Constraint Definition* in the form of an XML Schema to describe a class of *Entities* of the type “journal” (which includes “journal article”). This *Constraint Definition* is registered and available in the *Registry* at <http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:journal>. Therefore, it defines a registered *XML Metadata Format,* which can be identified using the “info” URI scheme.

In principle, registration is ***optional***, because an *XML Serialization* ***may*** use any XML Schema as a *Metadata Format* by identifying the XML Schema with its “http” URI in the **format** element. In practice, however, it is unlikely that *Resolvers* will be able to make sense of the metadata if an *XML Metadata Format* is not registered.

Table 19: XML Schema Constraint Definition of XML Metadata Format for “journal”

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema targetNamespace="info:ofi/fmt:xml:xsd:journal"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:jo="info:ofi/fmt:xml:xsd:journal"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
elementFormDefault="qualified" attributeFormDefault="unqualified"
xsi:schemaLocation="http://www.w3.org/2001/XMLSchema
http://www.w3.org/2001/XMLSchema.xsd">
    <xs:annotation>
          <xs:documentation>XML Schema defining the XML Metadata
Format to represent serially published documents, and its component
parts "issue" and "article". This XML Schema is available at
http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:journal</x
s:documentation>
          <xs:appinfo xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/">
                <dc:title>XML Format article</dc:title>
                <dc:creator>Committee NISO AX, OpenURL Standard
Committee</dc:creator>
                <dc:description>This XML Schema defines a format to
express properties of serial publications and their component
parts</dc:description>

    <dc:identifier>info:ofi/fmt:xml:xsd:journal</dc:identifier>

    <dc:identifier>http://www.openurl.info/registry/docs/info:ofi/fmt
:xml:xsd:journal</dc:identifier>
                <dcterms:created>2003-09-27</dcterms:created>
          </xs:appinfo>
    </xs:annotation>
    <xs:element name="journal" type="jo:journalType">
          <xs:annotation>
                <xs:documentation>The root element "journal" contains
child elements that are used to express properties of serial
publications</xs:documentation>
          </xs:annotation>
    </xs:element>
    <xs:complexType name="journalType">
          <xs:sequence>
                <xs:element name="authors" type="jo:authorType"
minOccurs="0">
```

```
                      <xs:annotation>
                            <xs:documentation>The "authors" element
contains child elements that are used to express authorship of an
individual article in a serial publication. The "authors" element is
not repeatable, it contains all authors, and allows for the
indication of the position of the author in the publication's list of
authors</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="atitle" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Article
title</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="title" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Journal title. Provided
for compatibility with OpenURL version 0.1. Usage of the "jtitle"
element is preferred</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="jtitle" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Journal title. Use the
most complete title available, e.g. "journal of the american medical
association". Abbreviated titles, when known, are provided in the
"stitle" element. Journal title information can also be provided in
the "title" element, which is provided for compatibility with OpenURL
version 0.1</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="stitle" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Abbreviated or short
journal title. This is used for journal title abbreviations, e.g. "J
Am Med Assn"</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="date" type="jo:dateType"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Date of publication in
ISO 8601 form YYYY, YYYY-MM or YYYY-MM-DD</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="chron" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Indications of
chronology in a non ISO8601 form (like "Spring" or "1st quarter")
should be carried in this element; the element content is not
normalized. Where numeric ISO8601 dates are also available, they
should be provided in the "date" element. As such, a recorded date of
publication of "Spring, 1992" becomes "date=1992" and "chron=spring".
Chronology information can also be provided in the "ssn" and
"quarter" elements</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="ssn" type="jo:ssnType"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Season (chronology).
Legitimate values are "spring", "summer", "fall",
"winter"</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="quarter" type="jo:quarterType"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Quarter (chronology).
Legitimate values are "1", "2", "3", "4"</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="volume" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Volume designation.
Volume is usually expressed as a number but could be roman numerals
or non-numeric, e.g. "124", or "VI"."4"</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="part" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Part can be a special
subdivision of a volume or it can be the highest level division of
the journal. Parts are often designated with letters or names, e.g.
"B", "Supplement"</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="issue" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>This is the designation
of the published issue of a journal, corresponding to the actual
```

```
physical piece in most cases. While usually numeric, it could be non-
numeric. Note that some publications use chronology in the place of
enumeration, i.e. Spring, 1998.</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="spage" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>First page number of a
start/end (spage-epage) pair. Note that pages are not always
numeric.</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="epage" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Second (ending) page
number of a start/end (spage-epage) pair</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="pages" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Start and end pages in
the form "startpage-endpage". This field can also be used for an
unstructured pagination statement when data relating to pagination
cannot be interpreted as a start-end pair, i.e. "A7, C4-9", "1-3,
6"</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="artnum" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Article number assigned
by the publisher. Article numbers are often generated for
publications that do not have usable pagination, in particular
electronic journal articles, e.g. "unifi000000090". If article
numbers are identifiers that follow a URI Scheme such as "info:doi/"
the information should be provided in the Identifier Descriptor of
the ContextObject, not in this "artnum" element. Likewise, if
articles are identified by means of a registered URI Scheme such as
the http scheme, the information should be provided in the
Identifier Descriptor of the ContextObject</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="issn" type="xs:string"
minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>International Standard
Serial Number (ISSN). ISSN numbers may contain a hyphen, e.g. "1041-
```

```
5653"</xs:documentation>
                    </xs:annotation>
              </xs:element>
              <xs:element name="eissn" type="xs:string"
minOccurs="0">
                    <xs:annotation>
                          <xs:documentation>ISSN for electronic
version of the journal. Although there is no distinction by format in
the assignment of ISSNs, some bibliographic services now carry both
the ISSN for the paper version and a separate ISSN for the electronic
version. This data element is included here to allow expression of
both types of ISSN numbers</xs:documentation>
                    </xs:annotation>
              </xs:element>
              <xs:element name="isbn" type="xs:string"
minOccurs="0">
                    <xs:annotation>
                          <xs:documentation>International Standard
Book Number (ISBN). The ISBN is usually presented as 9 digits plus a
final check digit (which may be "X"), e.g. "057117678X" . ISBN
numbers may contain hyphens, e.g. "1-878067-73-7"
                          </xs:documentation>
                    </xs:annotation>
              </xs:element>
              <xs:element name="coden" type="xs:string"
minOccurs="0">
                    <xs:annotation>

    <xs:documentation>CODEN</xs:documentation>
                    </xs:annotation>
              </xs:element>
              <xs:element name="sici" type="xs:string"
minOccurs="0">
                    <xs:annotation>
                          <xs:documentation>Serial Item and
Contribution Identifier (SICI)</xs:documentation>
                    </xs:annotation>
              </xs:element>
              <xs:element name="genre" type="jo:genreType"
minOccurs="0">
                    <xs:annotation>
                          <xs:documentation>Genre of the document.
Legitimate values for the "genre" element are: (1) "journal": for a
serial publication issued in successive parts (2) "issue": for one
instance of the serial publication (3) "article": for a document
published in a journal. (4) "conference": for a record of a
conference that includes one or more conference papers and that is
published as an issue of a journal or serial publication  (5)
"proceeding": for a single conference presentation published in a
journal or serial publication (6) "preprint": for an individual paper
```

```
  or report published in paper or electronically prior to its
  publication in a journal or serial (7) "unknown": use when the genre
  is unknown.</xs:documentation>
                      </xs:annotation>
                </xs:element>
          </xs:sequence>
    </xs:complexType>
    <xs:complexType name="authorType">
          <xs:choice maxOccurs="unbounded">
                <xs:element name="author"
  type="jo:detailedAuthorType" minOccurs="0"/>
                <xs:element name="au" type="xs:string" minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>The author's full name,
  i.e. "Smith, Fred M", "Harry S. Truman"</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="aucorp" type="xs:string"
  minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>Organization or
  corporation that is the author or creator of the book, i.e. "Mellon
  Foundation"</xs:documentation>
                      </xs:annotation>
                </xs:element>
          </xs:choice>
          <xs:attribute name="rank" type="xs:positiveInteger"
  use="optional">
                <xs:annotation>
                      <xs:documentation>An integer indicating the
  position of the author in the publication's list of authors , e.g.
  "1" for first author, "2" for second author, etc.</xs:documentation>
                </xs:annotation>
          </xs:attribute>
    </xs:complexType>
    <xs:complexType name="detailedAuthorType">
          <xs:sequence>
                <xs:element name="aulast" type="xs:string"
  minOccurs="0">
                      <xs:annotation>
                            <xs:documentation>The author's family
  name. This may be more than one word. In many citations, the author's
  family name is recorded first and is followed by a comma, i.e. Smith,
  Fred James is recorded as "aulast=smith"</xs:documentation>
                      </xs:annotation>
                </xs:element>
                <xs:element name="aufirst" type="xs:string"
  minOccurs="0">
                      <xs:annotation>
```

```
                        <xs:documentation>The  author's given
name or names or initials. This data element may contain multiple
words and punctuation, i.e. "Fred F", "Fred James"</xs:documentation>
                  </xs:annotation>
            </xs:element>
            <xs:element name="auinit" type="xs:string"
minOccurs="0">
                  <xs:annotation>
                        <xs:documentation>The author's first and
middle initials.</xs:documentation>
                  </xs:annotation>
            </xs:element>
            <xs:element name="auinit1" type="xs:string"
minOccurs="0">
                  <xs:annotation>
                        <xs:documentation>The author's first
initial.</xs:documentation>
                  </xs:annotation>
            </xs:element>
            <xs:element name="auinitm" type="xs:string"
minOccurs="0">
                  <xs:annotation>
                        <xs:documentation>The author's middle
initial.</xs:documentation>
                  </xs:annotation>
            </xs:element>
            <xs:element name="ausuffix" type="xs:string"
minOccurs="0">
                  <xs:annotation>
                        <xs:documentation>The author's name
suffix. Qualifiers on an author's name such as "Jr.", "III" are
entered here. i.e. Smith, Fred Jr. is recorded as
"ausuffix=jr"</xs:documentation>
                  </xs:annotation>
            </xs:element>
      </xs:sequence>
   </xs:complexType>
   <xs:simpleType name="dateType">
      <xs:union memberTypes="xs:gYear xs:gMonth xs:date"/>
   </xs:simpleType>
   <xs:simpleType name="ssnType">
      <xs:restriction base="xs:string">
            <xs:enumeration value="spring"/>
            <xs:enumeration value="summer"/>
            <xs:enumeration value="fall"/>
            <xs:enumeration value="winter"/>
      </xs:restriction>
   </xs:simpleType>
   <xs:simpleType name="quarterType">
```

```
            <xs:restriction base="xs:positiveInteger">
                  <xs:enumeration value="1"/>
                  <xs:enumeration value="2"/>
                  <xs:enumeration value="3"/>
                  <xs:enumeration value="4"/>
            </xs:restriction>
      </xs:simpleType>
      <xs:simpleType name="genreType">
            <xs:restriction base="xs:string">
                  <xs:enumeration value="journal"/>
                  <xs:enumeration value="issue"/>
                  <xs:enumeration value="article"/>
                  <xs:enumeration value="proceeding"/>
                  <xs:enumeration value="conference"/>
                  <xs:enumeration value="preprint"/>
                  <xs:enumeration value="unknown"/>
            </xs:restriction>
      </xs:simpleType>
  </xs:schema>
```

17 XML ContextObject Representations

Registry Identifier **info:ofi/fmt:xml:xsd:ctx**

Using the *XML Format*, one or more *ContextObjects* are expressed in an *XML Document.*

The *XML ContextObject Format* triple is as follows:

- The *XML Serialization* (see Section 16.1), recorded in the *Registry* under

  Registry Identifier **info:ofi/fmt:xml**

- The XML Schema *Constrain Language* (see Section 16.2), recorded in the *Registry* under

  Registry Identifier **info:ofi/fmt:xml:xsd**

- An XML Schema that specifies the actual constraints and structure for the *XML ContextObject Format*, recorded in the *Registry* under

  Registry Identifier: **info:ofi/fmt:xml:xsd:ctx**

Example 17 displays an *XML ContextObject Representation* that includes administrative data elements, two *Identifier Descriptors* to describe the *Referent, Identifier Descriptors* for the *ReferringEntity, Requester,* and *Referrer.* (Example 19 will show the use of *By-Value Metadata* in an *XML ContextObject Representation.*)

Example 17: XML ContextObject Representation

```
<?xml version="1.0" encoding="UTF-8"?>
<ctx:context-objects
  xmlns:ctx="info:ofi/fmt:xml:xsd:ctx"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="info:ofi/fmt:xml:xsd:ctx
http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:ctx">
 <ctx:context-object
       timestamp="2002-03-20T08:55:12Z"
       version="Z39.88-2004"
       identifier="456">
    <ctx:referent>
      <ctx:identifier>
           info:doi/10.1126/science.275.5304.1320
      </ctx:identifier>
      <ctx:identifier>info:pmid/9036860</ctx:identifier>
    </ctx:referent>
    <ctx:referring-entity>
      <ctx:identifier>info:doi/10.1006/mthe.2000.0239</ctx:identifier>
    </ctx:referring-entity>
    <ctx:requester>
      <ctx:identifier>mailto:jane.doe@caltech.edu</ctx:identifier>
    </ctx:requester>
    <ctx:referrer>
      <ctx:identifier>
           info:sid/elsevier.com:ScienceDirect
      </ctx:identifier>
    </ctx:referrer>
  </ctx:context-object>
</ctx:context-objects>
```

17.1 Cardinality Constraints on the XML ContextObject Format

The *XML ContextObject Format* restricts the number of *Entities* that ***may*** be present in each *ContextObject*, the number of *Descriptors* that ***may*** be used to describe *Entities*, and the number of *ContextObjects* that may be bundled in a single *XML Representation.* These constraints are specified and summarized in Table 20 (compare this with the fundamental restrictions of Table 1).

Table 20: XML ContextObject Format – Cardinality Constraints

Entities per ContextObject	Number	Descriptors			
		Identifier	By-Val. Metadata	By-Ref. Metadata	Private Data
Referent	1	≥ 0	≥ 0	≥ 0	≥ 0
ReferringEntity	≤ 1	≥ 0	≥ 0	≥ 0	≥ 0
Requester	≤ 1	≥ 0	≥ 0	≥ 0	≥ 0
ServiceType	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0
Resolver	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0
Referrer	≤ 1	≥ 0	≥ 0	≥ 0	≥ 0
ContextObjects	≥ 1	N/A	N/A	N/A	N/A

17.2 Entity and Descriptor Elements in the XML ContextObject Format

Table 21 gives an overview of the *XML ContextObject Format* by listing the appropriate XML element for each combination of *Entity* and *Descriptor.* The Table lists those elements as XPath expressions [2]. These XPath expressions are relative to the **ctx:context-object** element, not to the **ctx:context-objects** element.

For example:

- The XPath expression **//referent/identifier** of Table 21 addresses XML elements that describe a *Referent* by means of *Identifier Descriptors.* In the *XML ContextObject* of Example 17, two XML elements match this XPath expression. Their respective content is **info:doi/10.1126/science.275.5304.1320** and **info:pmid/9036860**.
- The XPath expression **//referent/metadata-by-val/format** of Table 21 addresses XML elements that identify *Metadata Formats* used for *By-Value Metadata* of a *Referent.* In the *XML ContextObject* of Example 22, one XML element matches this XPath expression. Its content is **info:ofi/fmt:xml:xsd:journal**. This particular *Metadata Format* is registered, as can be seen from its identifier in the **info:ofi/** namespace.

Table 21: XML ContextObject Format – Entities and Descriptors

Entities	Nr.	Descriptors			
		Identifier	By-Value Metadata	By-Reference Metadata	Private Data
Referent	1	**//referent/identifier**	**//referent/metadata-byval/format** **//referent/metadata-by-val/metadata**	**//referent/metadata-by-ref/format** **//referent/metadata-by-ref/location**	**//referent/private-data**
Referring-Entity	≤ 1	**//referring-entity/identifier**	**//referring-entity/metadata-by-val/format** **//referring-entity/metadata-by-val/metadata**	**//referring-entity/metadata-by-ref/format** **//referring-entity/metadata-by-ref/location**	**//referring-entity/private-data**
Requester	≤ 1	**//requester/identifier**	**//requester/metadata-by-val/format** **//requester/metadata-by-val/metadata**	**//requester/metadata-by-ref/format** **//requester/metadata-by-ref/format/location**	**//requester/private-data**
Service-Type	≥ 0	**//service-type/identifier**	**//service-type/metadata-by-val/format** **//service-type/metadata-by-val/metadata**	**//service-type/metadata-by-ref/format** **//service-type/metadata-by-ref/location**	**//service-type/private-data**
Resolver	≥ 0	**//resolver/identifier**	**//resolver/metadata-by-val/format** **//resolver/metadata-by-val/metadata**	**//resolver/metadata-by-ref/format** **//resolver/metadata-by-ref/location**	**//resolver/private-data**
Referrer	≥ 0	**//referrer/identifier**	**//referrer/metadata-by-val/format** **//referrer/metadata-by-val/metadata**	**//referrer/metadata-by-ref/format** **//referrer/metadata-by-ref/location**	**//referrer/private-data**

17.3 Administrative Elements and Attributes in the XML ContextObject Format

Table 22 lists the administrative elements and attributes of an *XML ContextObject Representation.* The *XML ContextObject Format* provides three ways to specify administrative information:

- Three optional attributes of the **context-object** element
- Community-specific administrative data contained in the **administration** child element of the **context-object** element
- Community-specific administrative data contained in the **administration** child element of the **context-objects** element

Table 22: XML ContextObject Format – Administrative Information

Item	Number	Element	Attribute	Definition
Administration	≤ 1	**//context-objects /administration**		Community-defined
Administration	≤ 1	**//context-object/ administration**		Community-defined
Version	≤ 1		**//context-object@ version**	Version of OpenURL Framework Standard. Fixed value of Z39.88-2004
Identifier	≤ 1		**//context-object@ identifier**	Identifier of *ContextObject*
Timestamp	≤ 1		**//context-object@ timestamp**	ISO8601datetime specifying the time of creation of the *ContextObject*

17.4 Character Encoding in the XML ContextObject Format

Character Encoding in the *XML ContextObject Format* follows the specifications provided by XML [1]. *XML ContextObject Representations* ***must*** use the UTF-8 encoding of Unicode. As is standard in *XML Documents,* character-encoding information is provided by the value of the encoding declaration in the XML declaration. Because UTF-8 is default for XML, the encoding declaration ***may*** be omitted. If the encoding declaration is present, it ***must*** specify UTF-8.

18 Entity Descriptors in the XML ContextObject Format

A *Descriptor* specifies information about an *Entity.* There are four types of *Descriptors* that **may** be used in the *XML ContextObject Format: Identifier, By-Value Metadata, By-Reference Metadata,* and *Private Data.*

18.1 Identifier Descriptors

An *Identifier Descriptor* specifies an *Entity* by means of a Uniform Resource Identifier (URI). This URI ***may*** be associated with the *Entity* itself or with metadata for the *Entity.* As described in Section 17.2, *Identifier Descriptors* in the *XML ContextObject Format* are represented using identifier elements.

Example 18 shows *Identifier Descriptors* for a *Referent,* a *Requester,* and a *Resolver.*

Example 18: Identifier Descriptors in an XML ContextObject Representation

```
<referent>
   <identifier>info:doi/10.1126/science.275.5304.1320</identifier>
</referent>
<referent>
   <identifier>info:pmid/9036860</identifier>
</referent>
<requester>
   <identifier>mailto:jane.doe@caltech.edu</identifier>
</requester>
<resolver>
   <identifier>http://links.caltech.edu/menu</identifier>
</resolver>
```

18.2 By-Value and By-Reference Metadata Descriptors

A *Metadata Format* provides a concrete set of descriptive elements for the purpose of representing an *Entity.* For compatibility, *Metadata Formats* and the *ContextObject Format* ***must*** be based on the same *Serialization* and *Constraint Language.* This compatibility rule is waived for *By-Reference Metadata,* provided the *Metadata Format* is registered (see Sections 9.2 and 18.2.1).

Metadata Formats used in the OpenURL Framework ***may*** be registered. Unregistered *Metadata Formats* must meet the requirements described in Section 9.2.

18.2.1 Rules Guiding By-Value and By-Reference Metadata Descriptors

The general rules for *Metadata Formats* are given in Section 9.2. This Section gives the rules for creating *By-Value Metadata* and *By-Reference Metadata* in the *XML ContextObject Format.* The *XML ContextObject Format* accommodates both registered and unregistered *Metadata Formats.*

- Registered *Metadata Formats*
  - Registered *Metadata Formats* ***must*** be identified by means of the *Registry Identifier* of the *Metadata Format.* The *Registry* maintains a one-to-one correspondence between the definition of a *Metadata Format* and its *Registry Identifier.* The identification of the *Metadata Format* ***must*** be provided as the content of the **format** element.
  - The corresponding *By-Value Metadata Descriptor* ***must*** use the *XML Serialization* and ***must*** conform to an XML Schema. This XML Schema ***must*** be in the *Registry* and correspond uniquely with the *Registry Identifier* used to identify the *Metadata Format.* The *Registry Identifier* of the *Metadata Format* ***must*** be of the form: **info:ofi/fmt:xml:xsd:format_name**.
  - The corresponding *By-Reference Metadata Descriptor* ***must*** be an instance document that conforms to the *Metadata Format* identified by the *Registry Identifier.* Because the *Metadata Format* is registered, the *By-Reference Metadata Descriptor* ***may*** use any registered *Serialization,* and the *Metadata Format* to which it conforms ***may*** use any

registered *Constraint Language.* The *By-Reference Metadata Descriptor* is not limited to the *XML Serialization* or the XML Schema *Constraint Language.*

- Unregistered *Metadata Formats*
  - Unregistered *Metadata Formats* ***must*** be identified by means of a URL that specifies the network location of the XML Schema that defines the *XML Metadata Format.* The identification of the *Metadata Format* ***must*** be provided as the content of the **format** element. For example, a *Metadata Format* could be identified as: **http://www.example.net/x-service.xsd**.
  - The corresponding *By-Value Metadata* or *By-Reference Metadata Descriptor* ***must*** use the *XML Serialization:* it ***must*** be an *XML Document* that conforms to the XML Schema at the network location specified by the aforementioned URL.

18.2.2 By-Value Metadata Descriptors

An *XML By-Value Metadata Descriptor* consists of a **metadata-by-val** element containing

- a **format** element containing the format identifier and
- a **metadata** element containing XML metadata conforming to the XML Schema identified in the **format** element.

Example 19: Referent with a By-Value Metadata Descriptor

```
<ctx:referent>
  <ctx:metadata-by-val>
    <ctx:format>info:ofi/fmt:xml:xsd:journal</ctx:format>
    <ctx:metadata>
      <rft:journal xmlns:rft="info:ofi/fmt:xml:xsd:journal"
  xsi:schemaLocation="info:ofi/fmt:xml:xsd:journal
  http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:journal">
        <rft:authors>
          <rft:author>
            <rft:aulast>Bergelson</rft:aulast>
            <rft:auinit>J</rft:auinit>
          </rft:author>
        </rft:authors>
        <rft:atitle>Isolation of a common receptor for coxsackie B viruses
  and adenoviruses 2 and 5
        </rft:atitle>
        <rft:jtitle>Science</rft:jtitle>
        <rft:date>1997</rft:date>
        <rft:volume>275</rft:volume>
        <rft:spage>1320</rft:spage>
        <rft:epage>1323</rft:epage>
      </rft:journal>
    </ctx:metadata>
  </ctx:metadata-by-val>
</ctx:referent>
```

Example 19 shows a *By-Value Metadata Descriptor* for a *Referent,* an article in a journal.

- The *XML Metadata Format* is identified by **info:ofi/fmt:kev:mtx:journal**. White space is trimmed from the element data.
- The XML metadata in the **ctx:metadata** element conforms to the specified XML Schema.
- The requirement to provide a *Format Identifier* in the **format** element is separate from and independent of the requirement made by XML Schema for elements to declare their XML namespace.

18.2.3 By-Reference Metadata Descriptors

An *XML By-Reference Metadata Descriptor* consists of a **metadata-by-ref** element containing

- a **format** element that specifies the URI of a *Metadata Format* and
- a **location** element that specifies the URL of *By-Reference Metadata* that conform to the *Constraint Definition* identified in the **format** element.

Example 20: Requester with a By-Reference Metadata Descriptor

```
<ctx:requester>
  <ctx:metadata-by-ref>
    <ctx:format>http://my.example.org/eduperson.xsd</ctx:format>
    <ctx:location>ldap://ldap.caltech.edu:389/janed</ctx:location>
  </ctx:metadata-by-ref>
</ctx:requester>
```

Example 20 shows a *By-Reference Metadata Descriptor* for a *Requester.* In this example, the *Requester* is Jane Doe, a student at Caltech, identified by her LDAP record.

- The *Metadata Format* is identified by **http://my.example.org/eduperson.xsd**. Because this *Metadata Format* is not registered, this ***must*** be the URL of an XML Schema.
- The *XML Document* retrieved from **ldap://ldap.caltech.edu:389/janed** ***should*** conform to the specified XML Schema.

18.3 Private Data Descriptors

A *Private Data Descriptor* specifies information about the *Entity* using a method not defined in this Standard. This Standard does not provide any global mechanisms to interpret *Private Data*. Instead, it is assumed that the *Resolver* and the *Referrer* have a common understanding, based on a tacit or explicit bilateral agreement. To make it possible for the *Resolver* to interpret *Private Data,* a *ContextObject* that contains *Private Data* ***must*** identify the *Referrer* that created it.

Example 21: ReferringEntity with a Private Data Descriptor

```
<referring-entity>
  <private-data>
    <x:citdata xmlns:x="http://example.org/x" cites="8" citedby="12"/>
  </private-data>
</referring-entity>
```

In Example 21, the information in the **referring-entity** element is XML from an external unidentified scheme. The meaning of data in the **private-data** element is defined by the *Referrer,* which is identified in the **referrer** element (not shown in the example).

18.4 Example of an XML ContextObject Representation

Example 22 shows an *XML Representation* of a *ContextObject* that combines several of the previous examples.

The first line is a common XML introduction that specifies the XML version number and the XML character encoding.

The **context-objects** element is an optional container to hold multiple **context-object** elements. The **context-objects** element includes appropriate XML namespace declarations that indicate to XML processors how to validate the *XML Document.*

In this example, the **context-objects** element holds only one **context-object** element. The attributes of the **context-object** element specify the administrative data of the *ContextObject:* time of creation, version of this Standard, and an optional identifier for the *ContextObject Representation.* The optional identifier might be used to assist in the retrieval of *ContextObject Representations.*

The *Referent* is described in the **referent** element by means of a *By-Value Metadata Descriptor* in the **metadata-by-val** element. The **format** element specifies the *XML Metadata Format* for a journal (**info:ofi/fmt:xml:xsd:journal**). This is followed by the **metadata** element, which holds a **journal** element that contains the actual metadata for the *Referent* in the specified *Metadata Format.* The **journal** element holds an **authors** element that lists the authors, an **atitle** element to specify the title of the article, a **jtitle** element to specify the title of the journal, a **date** element to specify the date of publication, a **volume** element, a **spage** element for the starting page, and an **epage** element for the end page of the article.

A *ReferringEntity* is described in the **referring-entity** element by means of an *Identifier Descriptor* in the **identifier** element.

The *Requester* is described in the ***requester*** element by means of a *By-Reference Metadata Descriptor* in the **metadata-by-ref** element. The latter contains a **format** element and a **location** element to specify, respectively, the *Metadata Format* and the location of the actual metadata. The *Metadata Format* for the *Requester* is identified by the URL **http://my.example.org/eduperson.xsd**. For the *ContextObject Representation* to be valid, the LDAP URL **ldap://ldap.caltech.edu:389/janed** ***must*** point to an *XML Document* that conforms to the XML Schema located at the URL of the *Metadata Format* (**http://my.example.org/eduperson.xsd**).

Finally, the *Referrer* is described in the **referrer** element by means of an *Identifier Descriptor* in the **identifier** element. This element contains an identifier from the **info:sid/** namespace used to identify of sources of information.

Example 22: XML ContextObject Representation

```
<?xml version="1.0" encoding="UTF-8"?>
<ctx:context-objects xmlns:ctx="info:ofi/fmt:xml:xsd:ctx"
xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance
xsi:schemaLocation="info:ofi/fmt:xml:xsd:ctx-2004
http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:ctx">
 <ctx:context-object timestamp="2002-06-14T12:13:00Z" version="Z39.88-
2004" identifier="125">
   <ctx:referent>
     <ctx:metadata-by-val>
       <ctx:format>info:ofi/fmt:xml:xsd:journal</ctx:format>
       <ctx:metadata>
         <rft:journal
             xmlns:rft="info:ofi/fmt:xml:xsd:journal"
             xsi:schemaLocation="info:ofi/fmt:xml:xsd:journal
```

```
http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:journal">
           <rft:authors>
             <rft:author>
               <rft:aulast>Bergelson</rft:aulast>
               <rft:auinit>J</rft:auinit>
             </rft:author>
           </rft:authors>
           <rft:atitle>Isolation of a common receptor for coxsackie B
viruses and adenoviruses 2 and 5</rft:atitle>
           <rft:jtitle>Science</rft:jtitle>
           <rft:date>1997</rft:date>
           <rft:volume>275</rft:volume>
           <rft:spage>1320</rft:spage>
           <rft:epage>1323</rft:epage>
         </rft:journal>
       </ctx:metadata>
     </ctx:metadata-by-val>
   </ctx:referent>
   <ctx:referring-entity>
     <ctx:identifier>info:doi/10.1006/mthe.2000.0239</ctx:identifier>
   </ctx:referring-entity>
   <ctx:requester>
     <ctx:metadata-by-ref>
       <ctx:format>http://my.example.org/eduperson.xsd</ctx:format>
       <ctx:location>ldap://ldap.caltech.edu:389/janed</ctx:location>
     </ctx:metadata-by-ref>
   </ctx:requester>
   <ctx:referrer>
     <ctx:identifier>info:sid/elsevier.com:ScienceDirect</ctx:identifier>
   </ctx:referrer>
  </ctx:context-object>
</ctx:context-objects>
```

19 XML-Based Community Profiles

A *Community Profile* lists a selection of *Registry* entries. This selection specifies the *ContextObject Format,* the *Metadata Format(s),* and the *Transport(s)* that form the core properties of an OpenURL *Application.* Further information on the creation of *Community Profiles* is found in Section 11.

A *Resolver* that conforms to the *XML ContextObject Format* ***must*** process all items that conform to *Registry* entries specified in a *Community Profile* using the *XML ContextObject Format.* Communities ***may*** define additional conformance rules in their *Community Profiles.*

Appendix D describes the Level 2 San Antonio *Community Profile,* which is an example of a *Community Profile* based on the *XML ContextObject Format.* This *Community Profile* was developed by NISO Committee AX for the scholarly-information community. In the remainder of this Standard, this *Community Profile* will be referred to as the SAP2 *Community Profile.* Its *Registry Identifier* is **info:ofi/pro:sap2-2004**.

Other communities are encouraged to use the XML *ContextObject Format* to deploy their own *OpenURL Framework Applications.* As specified in Section 11, each *Application* ***must*** be defined in a *Community Profile.* A straightforward way to deploy XML-based *Applications* is to modify the SAP2 *Community Profile* to the needs of new communities.

The OpenURL Framework for Context-Sensitive Services

Part 4: OpenURL Transports

Part 1 (Sections 5 through 11) defines the core components of the OpenURL Framework: *Namespaces, Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats, Transports,* and *Community Profiles*.

Parts 2, 3, and 4 (Sections 12 through 22) define instances of these core components that illustrate the abstract concepts of Part 1. These instances form the initial content of the *Registry.* Each instance is described, given a *Registry Identifier,* and entered into the *Registry* at <http://www.openurl.info/registry/>. The initial *Registry* launches two *Applications* of the OpenURL Framework Standard intended for the scholarly-information community. The first *Application* provides a migration path from OpenURL 0.1 to the OpenURL Framework Standard. The second *Application* provides a path for future growth by harnessing the full expressive power of XML.

Part 2 defines a *ContextObject Format* inspired by the query string of the HTTP(S) GET request as specified in OpenURL 0.1. Part 3 defines a *ContextObject Format* based on XML.

Part 4 (Sections 20, 21, and 22) defines six methods to convey *ContextObject Representations* over a network. All six methods use the HTTP and HTTPS protocols defined in IETF RFC 2616 [14]. They are collectively called *OpenURL Transports.* Four of these *Transports* are generic and ***may*** be used with any *ContextObject Format.* Two of the *Transports* are developed specifically for the *ContextObject Format* defined in Part 2 to provide a migration path from OpenURL 0.1 to this Standard. Communities ***may*** use these transports in new *Applications,* and/or they ***may*** choose to create and register new instances of *Transports.* For example, a community could consider defining a SOAP-based *Transport* for *XML ContextObject Representations.*

Section 20 specifies *By-Reference OpenURL Transports,* which use HTTP(S) as the network protocol to transport network locations of *ContextObject Representations.*

Section 21 specifies the *By-Value OpenURL Transports,* which use HTTP(S) as the network protocol to transport *ContextObject Representations.*

By-Reference and *By-Value OpenURL Transports* are generic: they ***may*** be used to transport *KEV ContextObject Representations, XML ContextObject Representations,* and *ContextObject Representations* based on other, yet-to-be-registered, *ContextObject Formats.*

Section 22 specifies *Inline OpenURL Transports,* which use HTTP(S) as the network protocol to transport *KEV ContextObject Representations* carried as KEV pairs in the HTTP(S) query string.

Inline OpenURL Transports ***may*** only be used to transport *KEV ContextObject Representations. Inline OpenURL Transports* ***must not*** be used to transport *ContextObject Representations* in any other *ContextObject Format. Inline OpenURL Transports* are primarily introduced to provide a migration path from the OpenURL 0.1 specification to this Standard. The Implementation Guidelines available at <http://www.openurl.info/registry/docs/implementation_guidelines/> provide the details of this upgrade path for the scholarly-information community.

The OpenURL 0.1 specification, which is not a *Transport* as defined by this Standard, is available in the *Registry* at <http://www.openurl.info/registry/docs/pdf/openurl-01.pdf>.

Note: The terms “by reference” and “by value” refer to basic programming techniques that are widely applicable. In this Standard, both techniques are used independently in two contexts: *Transports* and *Metadata.* Both *By-Reference* and *By-Value Transports* ***may*** transport *ContextObject Representations* that contain *By-Reference* and/or *By-Value Metadata.*

20 By-Reference OpenURL Transports

A *By-Reference OpenURL Transport* transports the network location of a *ContextObject Representation.* The *Representation* itself is not transported, but resides at a network location. Depending on the constraints of the *ContextObject Format,* the *Representation* stored at a network location ***may*** contain the description of one or more *ContextObjects.* The *By-Reference OpenURL Transport* ***may*** be used for a *ContextObject Representation* that conforms to any registered *ContextObject Format.*

The *By-Reference OpenURL Transport* uses the HTTP network protocol or its secure sibling, HTTPS. The *Registry Identifiers* for these *Transports* are:

By-Reference OpenURL Transport over HTTP	**info:ofi/tsp:http:openurl-by-ref**
By-Reference OpenURL Transport over HTTPS	**info:ofi/tsp:https:openurl-by-ref**

This Section describes both *Transports,* which are identical except for their use of HTTP or HTTPS as the respective network protocol.

For each transportation via the *By-Reference OpenURL Transport,* a base URL specifies the "Internet host and port, and path" of the target of the transportation, an HTTP(S)-based service called a *Resolver.*

A *By-Reference OpenURL Transport* ***may*** convey the network location of a *ContextObject Representation* via HTTP(S) GET or HTTP(S) POST.

Appendix E provides implementation guidelines for the *By-Reference OpenURL Transports.*

20.1 OpenURL Keys in By-Reference OpenURL Transports

A *By-Reference OpenURL Transport* uses KEV pairs with the following keys, either in the query string of an HTTP(S) GET request or in the message body of an HTTP(S) POST:

url_ver: OpenURL signature

- ***Required***
- Maximum occurrence: 1
- Format: fixed value is the case-sensitive character string "Z39.88-2004"
- Character set and character encoding: value is US-ASCII
- Example: **url_ver=Z39.88-2004**

url_tim: Datetime of the creation of the OpenURL

- ***Optional***
- Maximum occurrence: 1
- Format: ISO8601-conformant datetime in the YYYY-MM-DD or YYYY-MM-DDTHH:MM:SSZ representation
- Character set and character encoding: value is US-ASCII and ***may*** need URL-encoding
- Example (not URL-encoded for readability): **url_tim=2002-08-16T17:23:45Z**

url_ctx_fmt: *Registry Identifier* of the *ContextObject Format* of the referenced *ContextObject Representation*

- ***Required***
- Maximum occurrence: 1
- Format: *Registry Identifiers* for *ContextObject Formats* (see Section 6.2)
- Character set and character encoding: value is US-ASCII and ***may*** need URL-encoding
- Example (not URL-encoded for readability): **url_ctx_fmt= info:ofi/fmt:kev:mtx:ctx**

url_ctx_ref: Network location of the *ContextObject Representation*

- ***Required***
- Maximum occurrence: 1
- Dependency: requires **url_ctx_fmt**
- Format: network location (a URL)
- Character set and character encoding: value is US-ASCII and ***may*** need URL-encoding
- Example (not URL-encoded for readability): **url_ctx_ref=http://www.example.org/temp/12587.xml**

A foreign key in the *By-Reference OpenURL Transport* is any key that is not an OpenURL key. Foreign keys ***may*** be used in a *By-Reference OpenURL Transport,* but their meaning is not defined by the *Transport. Resolvers* ***may*** ignore KEV pairs with foreign keys.

20.2 By-Reference OpenURL Transports using HTTP(S) GET

In the HTTP(S) GET mode of the *By-Reference OpenURL Transport,* KEV pairs described in Section 20.1 are concatenated with the ampersand character ('&') to form the query string of an HTTP(S) GET request. The resulting query string is appended to the base URL of the target *Resolver,* and separated from it by a question mark ('?'). As specified by the syntax rules for URIs [6], the query string following this question mark ***must*** be URL-encoded.

Example 23: By-Reference OpenURL Transport using HTTP GET

Formatted for readability:

```
  http://www.example.net/menu?
         url_ver = Z39.88-2004
       & url_tim = 2002-08-16T17:23:45Z
       & url_ctx_fmt = info:ofi/fmt:kev:mtx:ctx
       & url_ctx_ref = http://www.example.org/temp/12587.txt
```

URL-encoded:

```
http://www.example.net/menu?url_ver=Z39.88-2004&url_tim=2002-08-16T17%3A
23%3A45Z&url_ctx_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Actx&url_ctx_ref=http
%3A%2F%2Fwww.example.org%2Ftemp%2F12587.txt
```

Example 23 illustrates the HTTP GET method of the *By-Reference OpenURL Transport* to transport the network location of a *KEV ContextObject Representation.* The first part is formatted for readability: the query string is not URL encoded, white space is introduced, and KEV pairs are on separate lines. The second part is formatted for actual use with a URL-encoded query string.

The base URL of the *Transport* (the network location of the *Resolver*) is **http://www.example.net/menu**. The value assigned to the **url_ctx_fmt** key is

info:ofi/fmt:kev:mtx:ctx. This declares that the referenced *ContextObject Representation* is based on the *KEV ContextObject Format.* The network location of the *ContextObject Representation* is the value assigned to the **url_ctx_ref** key: **http://www.example.org/temp/12587.txt**. This file ***must*** contain a set of ampersand-delimited KEV pairs that conform to the *KEV ContextObject Format.*

20.3 By-Reference OpenURL Transports using HTTP(S) POST

In the HTTP(S) POST mode of the *By-Reference OpenURL Transport,* the query string specified in Section 20.1 is carried in the message body of the HTTP(S) POST. The Content-Type of the HTTP(S) request ***must*** be **application/x-www-form-urlencoded**. Hence, the message body ***must*** be URL-encoded.

Example 24: By-Reference OpenURL Transport using HTTP POST

Formatted for readability:

```
  Base URL: http://www.example.net/menu
  POST http://www.example.net/menu HTTP/1.0
  Content-Length: 161
  Content-Type: application/x-www-form-urlencoded

    url_ver = Z39.88-2004
  & url_tim = 2002-08-16T17:23:45Z
  & url_ctx_fmt = info:ofi/fmt:xml:xsd:ctx
  & url_ctx_ref = http://www.example.net/temp/12587.xml
```

URL-encoded:

```
url_ver=Z39.88-2004&url_tim=2002-08-16T17%3A23%3A45Z&url_ctx_fmt=info%3A
ofi%2Ffmt%3Axml%3Axsd%3Actx&url_ctx_ref=http%3A%2F%2Fwww.example.net%2Ft
emp%2F12587.xml
```

Example 24 illustrates the HTTP POST method of the *By-Reference OpenURL Transport* of the network location of a *KEV ContextObject Representation.* The first part is formatted for readability, and the second part is URL-encoded query string formatted for actual use. The base URL of the *Transport* (the network location of the *Resolver*) is **http://www.example.net/menu**.

21 By-Value OpenURL Transports

A *By-Value OpenURL Transport* transports the actual *ContextObject Representation,* not its network location. Depending on the constraints of the *ContextObject Format*, the *Representation* ***may*** contain the description of one or more *ContextObjects.* The *By-Value OpenURL Transport* ***may*** transport a *ContextObject Representation* that conforms to any registered *ContextObject Format.*

The *By-Value OpenURL Transport* uses the HTTP network protocol or its secure sibling, HTTPS. The *Registry Identifiers* for these *Transports* are:

By-Value OpenURL Transport over HTTP	**info:ofi/tsp:http:openurl-by-val**
By-Value OpenURL Transport over HTTPS	**info:ofi/tsp:https:openurl-by-val**

This Section describes both *Transports,* which are identical except for their use of HTTP or HTTPS as the respective network protocol.

For each transportation via the *By-Value OpenURL Transport,* a base URL specifies the "Internet host and port, and path" of the target of the transportation, an HTTP(S)-based service called a *Resolver.*

A *By-Value OpenURL Transport* ***may*** convey a *ContextObject Representation* via HTTP(S) GET or HTTP(S) POST.

Appendix E provides implementation guidelines for the *By-Value OpenURL Transports.*

21.1 OpenURL Keys in By-Value OpenURL Transports

A *By-Value OpenURL Transport* uses KEV pairs with the following keys, either in the query string of an HTTP(S) GET request or in the message body of an HTTP(S) POST:

url_ver: OpenURL signature

- ***Required***
- Maximum occurrence: 1
- Format: fixed value is the case-sensitive character string "Z39.88-2004"
- Character set and character encoding: value is US-ASCII
- Example: **url_ver=Z39.88-2004**

url_tim: Datetime of the creation of the OpenURL

- ***Optional***
- Maximum occurrence: 1
- Format: ISO8601-conformant datetime, in the YYYY-MM-DD or YYYY-MM-DDTHH:MM:SSZ representation
- Character set and character encoding: value is US-ASCII and ***may*** need URL-encoding
- Example (not URL-encoded for readability): **url_tim=2002-08-16T17:23:45Z**

url_ctx_fmt: *Registry Identifier* of the *ContextObject Format* of the transported *ContextObject Representation*

- ***Required***
- Maximum occurrence: 1
- Format: *Registry Identifiers* for *ContextObject Formats* (see Section 6.2)
- Character set and character encoding: value is US-ASCII and ***may*** need URL-encoding
- Example (not URL-encoded for readability): **url_ctx_fmt=info:ofi/fmt:kev:mtx:ctx**

url_ctx_val: The actual *ContextObject Representation* expressed according to a registered *ContextObject Format*

- ***Required***
- Maximum occurrence: 1
- Dependency: requires **url_ctx_fmt**
- Format: *ContextObject Representation* conforming to a registered *ContextObject Format.* The value of the **url_ctx_val** key is a character string containing the actual *ContextObject Representation.*
- Character set and character encoding: The character set and character encoding of the value is the *Character Encoding* applied by the *ContextObject Format* used in the

transported *ContextObject Representation.* In the *KEV ContextObject Format,* the default *Character Encoding* is **info:ofi/enc:UTF-8**. The *ContextObject Representation* ***may*** specify other *Character Encodings* in the value associated with the **ctx_enc** key. However, because values are URL-encoded in the *KEV ContextObject Format,* the *ContextObject Representation* provided as the value of the **url_ctx_val** key must be US-ASCII. When provided on a *By-Value OpenURL Transport,* the value of the **url_ctx_val** key ***may*** need further URL-encoding.

- Example (not URL-encoded for readability):
  url_ctx_val= rft_id=info:doi/10.1126/science.275.5304.1320

A foreign key in the *By-Value OpenURL Transport* is any key that is not an OpenURL key. Foreign keys ***may*** be used in a *By-Value OpenURL Transport,* but their meaning is not defined by the *Transport. Resolvers* ***may*** ignore KEV pairs with foreign keys.

21.2 By-Value OpenURL Transports using HTTP(S) GET

In the HTTP(S) GET mode of the *By-Value OpenURL Transport,* KEV pairs described in Section 21.1 are concatenated with the ampersand character ('&') to form the query string of an HTTP(S) GET request. The resulting query string is appended to the base URL of the target *Resolver,* and separated from it by a question mark ('?'). As specified by the syntax rules for URIs [6], the query string following this question mark ***must*** be URL-encoded.

Example 25: By-Value OpenURL Transport using HTTP GET

Formatted for readability:

```
  http://www.example.net/menu?
        url_ver = Z39.88-2004
      & url_tim = 2002-08-16T17:23:45Z
      & url_ctx_fmt = info:ofi/fmt:kev:mtx:ctx
      & url_ctx_val = rft_id=info:doi/10.1126/science.275.5304.1320
```

URL-encoded:

```
url_ver=Z39.88-2004&url_tim=2002-08-16T17%3A23%3A45Z&url_ctx_fmt=info%3A
ofi%2Ffmt%3Akev%3Amtx%3Actx&url_ctx_val=rft_id%3Dinfo%253Adoi%252F10.112
6%252Fscience.275.5304.1320
```

Example 25 illustrates the HTTP GET method of the *By-Value OpenURL Transport* of a *KEV ContextObject Representation.* The first part is formatted for readability: the query string is not URL encoded, white space is introduced, and KEV pairs are on separate lines. The second part is formatted for actual use with a URL-encoded query string.

The base URL of the *Transport* (the network location of the *Resolver*) is **http://www.example.net/menu**. The value assigned to the **url_ctx_fmt** key is **info:ofi/fmt:kev:mtx:ctx**. This declares that the transported *ContextObject Representation* is based on the *KEV ContextObject Format.*

The value assigned to the **url_ctx_val** key is the actual *KEV ContextObject Representation.* Note how this value is URL-encoded twice. The first URL-encoding is required by the *KEV ContextObject Format* (see Section 13.4). It encodes the values assigned to the keys. The second URL-encoding is required by the syntax rules for URIs (see IETF RFC 2396 [6]). It encodes the *KEV ContextObject Representation.* The first encoding of

rft_id=info:doi/10.1126/science.275.5304.1320

replaces the colon character (':') with the character string "%3A" and the forward slash character ('/') with the character string "%2F" to obtain

rft_id=info%3Adoi%2F10.1126%2Fscience.275.5304.1320

The second URL-encoding replaces the equals character ('=') with the character string "%3D" and the percent character ('%') with the character string "%25" to obtain

rft_id%3Dinfo%253Adoi%252F10.1126%252Fscience.275.5304.1320

21.3 By-Value OpenURL Transports using HTTP(S) POST

In the HTTP(S) POST mode of the *By-Value OpenURL Transport,* the query string specified in Section 21.1 is carried in the message body of the HTTP(S) POST. The Content-Type of the HTTP(S) request ***must*** be **application/x-www-form-urlencoded**. Hence, the message body ***must*** be URL-encoded.

Example 26: By-Value OpenURL Transport using HTTP POST

Formatted for readability:

```
  base URL : http://www.example.net/menu

  POST http://www.example.net/menu HTTP/1.0
  Content-Length: 1279
  Content-Type: application/x-www-form-urlencoded

    url_ver = Z39.88-2004
  & url_tim = 2002-03-20T08:55:12Z
  & url_ctx_fmt = info:ofi/fmt:xml:xsd:ctx
  & url_ctx_val = <?xml version="1.0" encoding="UTF-8"?>

<ctx:context-object xmlns:ctx="info:ofi/fmt:xml:xsd:ctx"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="info:ofi/fmt:xml:xsd:ctx
http://www.openurl.info/registry/docs/info:ofi/fmt:xml:xsd:ctx"
timestamp="2002-06-14T12:13:00Z" version="Z39.88-2004" identifier="125">

  <ctx:referent>
    <ctx:identifier>info:doi/10.1126/science.275.5304.1320
    </ctx:identifier>
    <ctx:identifier>info:pmid/9036860</ctx:identifier>
  </ctx:referent>
  <ctx:referring-entity>
    <ctx:identifier>info:doi/10.1006/mthe.2000.0239</ctx:identifier>
  </ctx:referring-entity>
  <ctx:requester>
    <ctx:identifier>mailto:jane.doe@caltech.edu</ctx:identifier>
  </ctx:requester>
  <ctx:referrer>
    <ctx:identifier>info:sid/elsevier.com:ScienceDirect</ctx:identifier>
  </ctx:referrer>
</ctx:context-object>
```

URL-encoded:

```
url_ver=Z39.88-2004&url_tim=2002-03-20T08%3A55%3A12Z&url_ctx_fmt=info%3Ao
fi%2Ffmt%3Axml%3Axsd%3Actx&url_ctx_val=%3C%3Fxml%20version%3D%221.0%22%20
encoding%3D%22UTF-8%22%3F%3E%0D%3Cctx%3Acontext-object%20xmlns%3Actx%3D%2
2info%3Aofi%2Ffmt%3Axml%3Axsd%3Actx%22%20xmlns%3Axsi%3D%22http%3A%2F%2Fww
w.w3.org%2F2001%2FXMLSchema-instance%22%20xsi%3AschemaLocation%3D%22info%
3Aofi%2Ffmt%3Axml%3Axsd%3Actx%20http%3A%2F%2Fwww.openurl.info%2Fregistry%
2Fdocs%2Finfo%3Aofi%2Ffmt%3Axml%3Axsd%3Actx%22%20timestamp%3D%222002-06-1
4T12%3A13%3A00Z%22%20version%3D%22Z39.88-2004%22%20identifier%3D%22125%22
%3E%0D%3Cctx%3Areferent%3E%0D%3Cctx%3Aidentifier%3Einfo%3Adoi%2F10.1126%2
Fscience.275.5304.1320%3C%2Fctx%3Aidentifier%3E%0D%3Cctx%3Aidentifier%3Ei
nfo%3Apmid%2F9036860%3C%2Fctx%3Aidentifier%3E%0D%3C%2Fctx%3Areferent%3E%0
D%3Cctx%3Areferring-entity%3E%0D%3Cctx%3Aidentifier%3Einfo%3Adoi%2F10.100
6%2Fmthe.2000.0239%3C%2Fctx%3Aidentifier%3E%0D%3C%2Fctx%3Areferring-entit
y%3E%0D%3Cctx%3Arequester%3E%0D%3Cctx%3Aidentifier%3Emailto%3Ajane.doe%40
caltech.edu%3C%2Fctx%3Aidentifier%3E%0D%3C%2Fctx%3Arequester%3E%0D%3Cctx%
3Areferrer%3E%0D%3Cctx%3Aidentifier%3Einfo%3Asid%2Felsevier.com%3AScience
Direct%3C%2Fctx%3Aidentifier%3E%0D%3C%2Fctx%3Areferrer%3E%0D%3C%2Fctx%3Ac
ontext-object%3E%0D
```

Example 26 illustrates the HTTP POST method of the *By-Value OpenURL Transport* of an *XML ContextObject Representation.* The first part is formatted for readability, and the second part is formatted for actual use with a double URL-encoding as explained in Section 21.2.

The base URL of the *Transport* (the network location of the *Resolver*) is **http://www.example.net/menu**. The value assigned to the **url_ctx_fmt** key is **info:ofi/fmt:xml:xsd:ctx**. This declares that the transported *ContextObject Representation* is based on the *XML ContextObject Format.* The *XML ContextObject Representation* is provided as the value assigned to the **url_ctx_va**l key.

As noted in Table 20, the *XML ContextObject Format* allows bundling multiple *ContextObjects* into one *XML ContextObject Representation.* An *XML ContextObject Representation* ***may***, therefore, contain the description of multiple *ContextObjects,* all of which are conveyed in a single transportation.

22 Inline OpenURL Transports

An *Inline OpenURL Transport* transports exactly one *KEV ContextObject Representation* as part of the query string used in an HTTP(S) GET request or in the message body of an HTTP(S) POST. This differs from the *By-Value OpenURL Transport,* where the *KEV ContextObject Representation* is the value associated with the **url_ctx_val** key.

The *Inline OpenURL Transport* strongly resembles OpenURL 0.1. The *Inline OpenURL Transport* ***may*** be used only for the transportation of one, and only one, *KEV ContextObject Representation.* It ***must not*** be used for the transportation of *ContextObject Representations* that conform to any other *ContextObject Format.*

The *Inline OpenURL Transport* uses the HTTP network protocol or its secure sibling, HTTPS. The *Registry Identifiers* for these *Transports* are:

Inline OpenURL Transport over HTTP	**info:ofi/tsp:http:openurl-inline**
Inline OpenURL Transport over HTTPS	**info:ofi/tsp:https:openurl-inline**

This Section describes both *Transports,* which are identical except for their use of HTTP or HTTPS as the respective network protocol.

For each transportation of a *KEV ContextObject Representation* via the *Inline OpenURL Transport,* a base URL specifies the "Internet host and port, and path" of the target of the transportation, an HTTP(S)-based service called a *Resolver.*

An *Inline OpenURL Transport* conveys exactly one *KEV ContextObject Representation* via HTTP(S) GET and HTTP(S) POST.

The *KEV ContextObject Format* supports *Character Encodings* other than the default UTF-8 encoded Unicode. As a result, it is possible to submit *KEV ContextObjects Representations* via HTML forms. The *Character Encoding* is declared by assigning a value to the **ctx_enc** key. This value ***must*** be a *Registry Identifier* of a registered *Character Encoding.*

Appendix E provides implementation guidelines for the *Inline OpenURL Transports.*

22.1 OpenURL Keys in Inline OpenURL Transports

An *Inline OpenURL Transport* uses KEV pairs with the following keys, either in the query string of an HTTP(S) GET request or in the message body of an HTTP(S) POST:

url_ver: OpenURL signature

- ***Required***
- Maximum occurrence: 1
- Format: fixed value is the case-sensitive character string "Z39.88-2004"
- Character set and character encoding: value is US-ASCII
- Example: **url_ver=Z39.88-2004**

url_tim: Datetime of the creation of the OpenURL

- ***Optional***
- Maximum occurrence: 1
- Format: ISO8601-conformant datetime, in the YYYY-MM-DD or YYYY-MM-DDTHH:MM:SSZ representation
- Character set and character encoding: value is US-ASCII and ***may*** need URL-encoding
- Example (not URL-encoded for readability): **url_tim=2002-08-16T17:23:45Z**

url_ctx_fmt: *Registry Identifier* of the *ContextObject Format* of the transported *ContextObject Representation,* which ***must*** be the KEV ContextObject Format

- ***Optional***
- Maximum occurrence: 1
- Format: fixed value **info:ofi/fmt:kev:mtx:ctx**
- Character set and character encoding: value is US-ASCII and ***may*** need URL-encoding
- Example (not URL-encoded for readability): **url_ctx_fmt=info:ofi/fmt:kev:mtx:ctx**

A foreign key in the *Inline OpenURL Transports* is any key that is <u>not</u>:

- One of the above OpenURL keys
- A key from the *KEV ContextObject Format,* which are:
  - Administrative keys (prefixed by **ctx_**).The first encoding is called for by the *KEV ContextObject Format;* see Section 13.4. The second encoding is called for by the syntax rules for URIs; see IETF RFC 2396 [6].

– *Entity* Keys (prefixed by **rft_**, **rfe_**, **req_**, **rfr_**, **res_**, or **svc_**).

– Keys from *KEV Metadata Formats* (prefixed by **rft.**, **rfe.**, **req.**, **rfr.**, **res.,** or **svc.**).

Foreign keys ***may*** be used in an *Inline OpenURL Transport,* but their meaning is not defined by the *Transport. Resolvers* ***may*** ignore KEV pairs with foreign keys.

22.2 Inline OpenURL Transports using HTTP(S) GET

In the HTTP(S) GET mode of the *Inline OpenURL Transport,* the query string of an HTTP(S) GET request is the union of the following three sets of KEV pairs:

- A set of KEV pairs with keys from the list of the OpenURL keys described in Section 22.1
- A set of KEV pairs from one, and only one, *KEV ContextObject Representation*
- A set of KEV pairs with foreign keys, which have no meaning assigned by the OpenURL Framework and ***may*** be ignored by Resolvers

It is ***recommended*** to strip the query string from a leading ampersand (if there is one).

The resulting set of KEV pairs is expressed as an ampersand-delimited string. The order in which the KEV pairs happen to be concatenated in that string is insignificant, and no meaning ***should*** be inferred from the order.

The resulting query string is appended to the base URL of the target *Resolver,* and separated from it by a question mark (‘?’). As specified by the syntax rules for URIs [6], the query string following this question mark ***must*** be URL-encoded. Note that, by definition of the *KEV ContextObject Format*, the values of all KEV pairs in a *KEV ContextObject Representation* are URL-encoded.

Example 27: Inline OpenURL Transport using HTTP GET

Formatted for readability:

```
http://www.example.net/menu?
url_ver = Z39.88-2004
& url_tim = 2002-03-20T08:55:12Z
& url_ctx_fmt = info:ofi/fmt:kev:mtx:ctx
& rft_id = info:doi/10.1126/science.275.5304.1320
& rft_id = info:pmid/9036860
& rft_val_fmt = info:ofi/fmt:kev:mtx:journal
& rft.jtitle = Science
& rft.atitle = Isolation of a common receptor for coxsackie B viruses
and adenoviruses 2 and 5
& rft.aulast = Bergelson
& rft.auinit = J
& rft.date = 1997
& rft.volume = 275
& rft.spage = 1320
& rft.epage = 1323
& rfe_id = info:doi/10.1006/mthe.2000.0239
& rfr_id = info:sid/elsevier.com:ScienceDirect
& req_id = mailto:jane.doe@caltech.edu
& ctx_tim = 2002-03-20T08:55:12Z
& ctx_enc = info:ofi/enc:UTF-8
```

URL-encoded:

```
http://www.example.net/menu?url_ver=Z39.88-2004&url_tim=2002-03-20T08%3A5
5%3A12Z&url_ctx_fmt=info%3Aofi%2Ffmt%3Akev%3Amtx%3Actx&rft_id=info%3Adoi%
2F10.1126%2Fscience.275.5304.1320&rft_id=info%3Apmid%2F9036860&rft_val_fm
t=info%3Aofi%2Ffmt%3Akev%3Amtx%3Ajournal&rft.jtitle=Science&rft.atitle=Is
olation%20of%20a%20common%20receptor%20for%20coxsackie%20%20B%20viruses%2
0and%20adenoviruses%202%20and%20%205&rft.aulast=Bergelson&rft.auinit=J&rf
t.date=1997&rft.volume=275&rft.spage=1320&rft.epage=1323&rfe_id=info%3Ado
i%2F10.1006%2Fmthe.2000.0239&rfr_id=info%3Asid%2Felsevier.com%3AScienceDi
rect&req_id=mailto%3Ajane.doe%40caltech.edu&ctx_tim=2002-03-20T08%3A55%3A
12Z&ctx_enc=info%3Aofi%2Fenc%3AUTF-8
```

Example 27 illustrates the HTTP GET method of the *Inline OpenURL Transport* of a *KEV ContextObject Representation.* The first part is formatted for readability: the query string is not URL encoded, white space is introduced, and KEV pairs are on separate lines. The second part is formatted for actual use with a URL-encoded query string.

The base URL of the *Transport* (the network location of the *Resolver*) is **http://www.example.net/menu**. The value assigned to the **url_ctx_fmt** key is **info:ofi/fmt:kev:mtx:ctx**. This declares that the transported *ContextObject Representation* is based on the *KEV ContextObject Format* (as is required for an *Inline OpenURL Transport*). The absence of both the **url_ctx_ref** and **url_ctx_val** keys indicates that this is an *Inline OpenURL Transport.* (The presence of the **url_ctx_ref** key would have indicated a *By-Reference OpenURL Transport.* The presence of the **url_ctx_val** key would have indicated a *By-Value OpenURL Transport.*)

The KEV pairs starting with **& rft_id = info:doi/10.1126/science.275.5304.1320** and ending with **& ctx_enc = info:ofi/enc:UTF-8** form the *KEV ContextObject Representation,* consisting of two *Identifier Descriptors* for the *Referent* (**rft_id**), a *By-Value Metadata Descriptor* for the *Referent* (**rft_val_fmt**, keys with a **rft.** prefix), one *Identifier Descriptor* for a *ReferringEntity* (**rfe_id**), one *Identifier Descriptor* for a *Referrer* (**rfr_id**), and one *Identifier Descriptor* for a *Requester* (**req_id**). The last two KEV pairs specify the time of creation of the *ContextObject Representation* (**ctx_tim**) and the *Character Encoding* used (**ctx_enc**).

The *By-Value Metadata Descriptor* of the *Referent* consists of two parts. The first part is a KEV pair that declares the *Metadata Format* (**rft_val_fmt = info:ofi/fmt:kev:mtx:journal**), in this case a journal publication in the *KEV Metadata Format.* The second part is a set of KEV pairs that specify the actual metadata in the specified *KEV Metadata Format.* These KEV pairs have keys with the **rft.** prefix to indicate that they represent the *Referent.*

22.3 Inline OpenURL Transports using HTTP(S) POST

In the HTTP(S) POST mode of the *Inline OpenURL Transport,* the query string specified in Section 22.2 is carried in the message body of the HTTP(S) POST. The Content-Type of the HTTP(S) request ***must*** be **application/x-www-form-urlencoded**. Hence, the message body ***must*** be URL-encoded. Note that the *KEV ContextObject Format* already requires that values of all KEV pairs occurring in a *KEV ContextObject Representation* be URL-encoded.

Example 28 shows an HTML form that uses the POST method. It is assumed that the form is inserted in an HTML page that uses UTF-8 for character encoding. The result of submitting the form is the *Inline OpenURL Transport* of Example 29. It illustrates the HTTP POST method of the *Inline OpenURL Transport* of a *KEV ContextObject Representation.* The base URL of the *Transport* is the network location of the *Resolver:* **http://www.example.net/menu**.

Example 28: An HTML Form (POST Method) to generate an Inline OpenURL Transport

```
<form method="POST" action="http://www.example.net/menu">
<input type="hidden" name="url_ver" value="Z39.88-2004">
<input type="hidden" name="url_ctx_fmt"
value="info:ofi/fmt:kev:mtx:ctx">
<input type="hidden" name="rft_id"
value="info:doi/10.1126/science.275.5304.1320">
<input type="hidden" name="rft_id" value="info:pmid/9036860">
<input type="hidden" name="rft_val_fmt"
value="info:ofi/fmt:kev:mtx:journal">
<input type="hidden" name="rft.jtitle" value="Science">
<input type="hidden" name="rft.atitle" value="Isolation of a common
receptor for coxsackie B viruses and adenoviruses 2 and 5">
<input type="hidden" name="rft.aulast" value="Bergelson">
<input type="hidden" name="rft.auinit" value="J">
<input type="hidden" name="rft.date" value="1997">
<input type="hidden" name="rft.volume" value="275">
<input type="hidden" name="rft.spage" value="1320">
<input type="hidden" name="rft.epage" value="1323">
<input type="hidden" name="req_id" value="
mailto:jane.doe@caltech.edu">
<input type="hidden" name="rfr_id"
       value="info:sid/elsevier.com:ScienceDirect">
<input type="hidden" name="ctx_tim" value="2002-03-20T08:55:12Z">
<input type="hidden" name="ctx_enc" value="info:ofi/enc:UTF-8">
<input type="submit" value="send OpenURL">
</form>
```

Example 29: Inline OpenURL Transport using HTTP POST

Formatted for readability:

```
base URL : http://www.example.net/menu

POST http://www.example.net/menu HTTP/1.0
Content-Length: 1480
Content-Type: application/x-www-form-urlencoded

  url_ver = Z39.88-2004
& url_tim = 2002-03-20T08:55:12Z
& url_ctx_fmt = info:ofi/fmt:kev:mtx:ctx
& rft_id = info:doi/10.1126/science.275.5304.1320
& rft_id = info:pmid/9036860
& rft_val_fmt = info:ofi/fmt:kev:mtx:journal
& rft.jtitle = Science
& rft.atitle = Isolation of a common receptor for coxsackie  B
viruses and adenoviruses 2 and 5
& rft.aulast = Bergelson
& rft.auinit = J
& rft.date = 1997
```

```
  & rft.volume = 275
  & rft.spage = 1320
  & rft.epage = 1323
  & rfe_id = info:doi/10.1006/mthe.2000.0239
  & rfr_id = info:sid/elsevier.com:ScienceDirect
  & req_id = mailto:jane.doe@caltech.edu
  & ctx_tim = 2002-03-20T08:55:12Z
  & ctx_enc = info:ofi/enc:UTF-8
```

The URL-encoded message body is the same as the URL-encoded part of Example 27.

Appendix A Responsibilities of the Maintenance Agency for the OpenURL Framework Standard

(informative)

(This appendix is not part of *The OpenURL Framework for Context Sensitive Services*, ANSI/NISO Z39.88-2004. It is included for information only.)

Upon approval of this Standard, NISO will establish one or more Maintenance Agencies for the OpenURL standard. The primary responsibility of a Maintenance Agency is to provide ongoing maintenance of the *Registry* to guarantee stability. Specifically, a Maintenance Agency is responsible to:

- Develop processes and procedures for *Registry* maintenance and updating consistent with this Standard.
- Facilitate the registration of new entries.
  When introducing new items into the *Registry,* a Maintenance Agency should maintain the *Registry* structure described in Section 6.3. If necessary, a Maintenance Agency may create new areas in the *Registry* to accommodate new types of *Registry* entries.
- Correct registry errors.
  Registered entries are fixed and unchangeable to the maximum practical extent possible. Under exceptional circumstances and with adequate community notification, a Maintenance Agency may correct errors in registered entries. However, a Maintenance Agency must not alter entries for the purpose of introducing new features or accommodating evolving usage. Instead, such evolution must be implemented through the registration of new entries.
- Provide an appropriate machine interface for downloading *Registry* materials.
  The initial *Registry* developed by the Committee supports the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) [17]. Systems may cache *Registry* materials locally to ensure reliable operation, whether or not the *Registry* is available. It is the responsibility of system developers to update their cached copies.
- Create and maintain an area in the Registry dedicated to security considerations.
  In this area, the Maintenance Agency should post implementation guidelines and/or requirements to prevent abuse of the OpenURL Framework.

Appendix B
Specification of the Z39.88-2004 Matrix Constraint Language

(normative)

B.1 The Z39.88-2004 Matrix Constraint Language

Registry Identifier **info:ofi/fmt:kev:mtx**

The Z39.88-2004 Matrix *Constraint Language* is used to specify constraints for descriptions of resources expressed using the *KEV Serialization.* The Z39.88-2004 Matrix *Constraint Language* is used to define the syntax and semantics of the *KEV ContextObject Format* and *KEV Metadata Formats*.

The Z39.88-2004 Matrix document is expressed in XHTML using a table format to define keys and data types of potential values for the keys. Table 24 displays the complete XHTML underlying the construction of Z39.88-2004 Matrices. This is also available in the *Registry* at <http://www.openurl.info/registry/docs/html/mtx.html>.

Table 23: Structure of the Z39.88-2004 Matrix

Delim	Key	Equals	Value	Min	Max	Description
&	**[** Key **]**	**=**	**<[** Value **]>**	0	1	[** Item definition **]
#	[** ... **]	[** … **]	[** … **]	[** … **]	[** … **]	[** This is a comment row **]

Table 23 shows the structure of a Z39.88-2004 Matrix. It consists of the following columns:

- Delim: the ampersand character ('&') delimiter for rows containing syntax rules or the hash character ('#') for comment rows
- Key: the key being defined
- Equals character ('=')
- Value: the data type for the value associated with the key
- Min: the minimum occurrence allowed for the key; an integer
- Max: the maximum occurrence allowed for the key; an integer or an asterisk character ('*') to denote 'unbounded'
- Description: a full name of the key, a semantic definition of the key, and any further information

Each row of the Z39.88-2004 Matrix with an ampersand character ('&') in the first column describes the construction of a valid KEV pair. Rows of the Z39.88-2004 Matrix that have a hash character ('#') in the first column are comment rows and ***must*** be ignored.

One valid KEV pair is obtained by concatenating table entries from the first four columns of a Z39.88-2004 Matrix row that begins with an ampersand character ('&'). Several valid KEV pairs ***may*** be concatenated to obtain a description of a resource compliant with a Z39.88-2004 *Constraint Definition.* The order in which KEV pairs are concatenated is not important.

In comment rows, replace the character string "[** ... **]" with descriptive text. Descriptive text ***must not*** occur in the Delim column. Usually, only the Description column contains descriptive text.

In the Key column of non-comment rows, the character string "**[** Key **]**" ***must*** be replaced with the name of a valid key.

The Value column of a non-comment row of the Z39.88-2004 Matrix assigns a data type to the key, and **[** Value **]** ***should*** be replaced with one of the following available data types:

- <data>: character string
- <id>: character string for an *Identifier* (Section 5.2.1)
- <fmt-id>: character string for a *Format Identifier* (Sections 8.2 and 9.2)
- <m-key>: character string for a metadata key (Section 14.2)
- <url>: character string for a URL [6]
- <date>: character string of the form [YYYY-MM-DD| YYYY-MM | YYYY], which represents a date formatted according to the W3C DTF profile of ISO 8601 [12]
- <time>: character string of the form [YYYY-MM-DDThh:mm:ssTZD], which represents a complete date plus hours, minutes, and seconds formatted according to the W3C DTF profile of ISO 8601 [12]

In the Description column, [** Item definition **] ***should*** be replaced with descriptive text containing the full name of the key, a semantic definition of the key, and any additional useful information.

B.2 Constraint Definitions in the KEV ContextObject Format

The main *Constraint Definition* associated with the *KEV Serialization* and the Z39.88-2004 Matrix *Constraint Language* is the *KEV ContextObject Format.* This *Format* defines the *Representation* of a *ContextObject* as a concatenation of KEV pairs of the form **&key=value**.

In addition, there are *Constraint Definitions* known as *KEV Metadata Formats* that define the *Representation* of *Entities* of *ContextObjects* as a concatenation of KEV pairs. These *Representations* ***may*** be used for both *By-Value* and/or *By-Reference Metadata Descriptors*.

In the *Registry,* a *Constraint Definition* for a *Format* expressed in the Z39.88-2004 Matrix *Constraint Language* is described by the following metadata:

- **dc:title**: the title of the *Format*
- **dc:creator**: the name of the community that defined the *Format*
- **dc:description**: a brief description of the *Format*
- **dc:identifier**: a locator of the Z39.88-2004 Matrix that defines the *Format*
- **dcterms:created**: the date when the *Format* was created
- **dcterms:modified**: the date when the *Format* was modified

Z39.88-2004 Matrix definitions are primarily intended for human reading. To this end, the XHTML Matrix has an associated style sheet that displays the first four rows of each column in bold type to highlight the syntax embedded in the Matrix. However, machine reading is supported, and each cell of the Matrix has an associated class attribute. The W3C XHTML validator button at the foot of the page ***should*** be used to validate the XHTML Matrix.

The template for the Z39.88-2004 Matrix displayed in Table 24, which ***may*** be used in the creation of *KEV ContextObject* and *Metadata Formats,* is also available in the *Registry* at <http://www.openurl.info/registry/docs/html/mtx.html>.

Table 24: XHTML Template for Z39.88-2004 Matrix

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" lang="en" xml:lang="en">
<head>
<title>[** XX **] Format Matrix</title>
<link rel="schema.DC" href="http://purl.org/DC/elements/1.0/"
title="Dublin Core Metadata Element Set, Version 1.1" />
<meta name="DC.title" content="[** XX **] Template Matrix" />
<meta name="DC.creator" content="NISO Committee AX" />
<meta name="DC.subject" content="OpenURL; ContextObject" />
<meta name="DC.date" scheme="W3CDTF" content="[** YYYY-MM-DD **]" />
<meta name="DC.type" content="Text" />
<meta name="DC.format" scheme="IMT" content="text/html" />
<meta name="DC.identifier" content="[** URI of mtx_?.html **]" />
<meta name="DC.language" content="en" />
<style type="text/css">
body {background: white none; color: black; font-family: arial, helvetica,
sans-serif}
p, h1, h2, h3, tr, th, td, li, ul, ol, dl, dt, dd {font-family:
arial,helvetica,sans-serif}
h1 {font-size: 140%; font-weight: bold}
h2 {font-size: 120%; font-weight: bold}
h3 {font-size: 110%; font-weight: bold}
.mtxDelim, .mtxKey, .mtxEquals, .mtxValueType {font-weight: bold}
</style></head>
<body>
<!-- Template for Z39.88-2004 Matrix. Fill in the blanks - marked [** ...
**] -->

<h1>Matrix defining the KEV [** XX **] Format</h1>
<hr /><p></p>

<table summary="Matrix administrative metadata" dir="ltr" border="1">
<tr><th scope="row" align="left">dc:title</th>
<td class="fmtTitle">KEV [** XX **] Format</td></tr>
<tr><th scope="row" align="left">dc:creator</th>
<td class="fmtCreator">NISO Committee AX, OpenURL Standards
Committee</td></tr>
<tr><th scope="row" align="left">dc:description</th>
<td class="fmtDesc">This Matrix represents the [** XX **] Format as a
string of ampersand-delimited Key/Encoded-Value pairs</td></tr>
<tr><th scope="row" align="left">dc:identifier</th>
<td class="fmtId">info:ofi/fmt:kev:mtx:[**format-id**]</td></tr>
<tr><th scope="row" align="left">dcterms:created</th>
<td class="fmtCreateDate">[** YYYY-MM-DD **]</td></tr>
<tr><th scope="row" align="left">dcterms:modified</th>
<td class="fmtUpdateDate">&nbsp;</td></tr>
```

```
</table>

<p>A representation of a Key/Encoded-Value pair is generated by
concatenating the contents of the first four columns of a row that begins
with an ampersand in the <a href=”#theMtx”>Matrix</a> below. The ordering
of KEV pairs is not important. Rows which have '#' in the first column are
comments and <strong>should not</strong> be included in the
representation.</p>

<p>The following data types are provided for the values of the Keys, which
must be URL-encoded:</p>

<table summary="Matrix data types" dir="ltr" border="1">
<tr><th scope="row" align="left">&lt;data&gt;</th>
<td class="mtxData">Character string</td></tr>
<tr><th scope="row" align="left">&lt;id&gt;</th>
<td class="mtxId">Character string for an Identifier (Z39.88-2004, Part 1,
Section 7)</td></tr>
<tr><th scope="row" align="left">&lt;fmt-id&gt;</th>
<td class="mtxFmtId">Character string for a Format Identifier (Z39.88-
2004, Part 1, Section 12)</td></tr>
<tr><th scope="row" align="left">&lt;m-key&gt;</th>
<td class="mtxMkey">Character string for a Metadata Key (Z39.88-2004, Part
2, Section 8.1)</td></tr>
<tr><th scope="row" align="left">&lt;url&gt;</th>
<td class="mtxURL">Character string for a <a
href="http://www.ietf.org/rfc/rfc2396.txt">URL</a></td></tr>
<tr><th scope="row" align="left">&lt;date&gt;</th>
<td class="mtxDate">Character string representing a date to the complete
date level of the <a href="http://www.w3.org/TR/NOTE-datetime">W3CDTF</a>
profile of ISO 8601, of the form: [ YYYY-MM-DD | YYYY-MM | YYYY
]</td></tr>
<tr><th scope="row" align="left">&lt;time&gt;</th>
<td class="mtxTime">Character string representing a date to the seconds
level of the <a href="http://www.w3.org/TR/NOTE-datetime">W3CDTF</a>
profile of ISO 8601, of the form: [ YYYY-MM-DDThh:mm:ssTZD | YYYY-MM-DD
]</td></tr>
</table>

<p>Abbreviations in column headings:</p>
<ul>
<li>Delim - Delimiter</li>
<li>Min - minimum occurrence</li>
<li>Max - maximum occurrence ('*' = unbounded)</li>
</ul>

<a name=”theMtx”></a><h2>The Matrix</h2>

<!-- Start of table representing Matrix -->
<table class="fmtMatrix" summary="KEV [** XX **] Format Matrix" dir="ltr"
```

```
border="1">
<!-- Table heading -->
<tr><th scope="col">Delim</th><th scope="col">Key</th><th
scope="col">Equals</th>
<th scope="col">Value</th><th scope="col">Min</th><th scope="col">Max</th>
<th scope="col">Description</th></tr>

<!-- Key definition row repeat as required -->
<tr class="mtxRule">
<!-- Delimiter: &amp; -->
  <td class="mtxDelim">&amp;</td>
<!-- Key -->
  <td class="mtxKey">[** Key **]</td>
<!-- Always = -->
  <td class="mtxEquals">=</td>
<!-- Value data type from table above -->
  <td class="mtxValueType">&lt;[** data **]&gt;</td>
<!-- Minimum occurrence: usually 0 -->
  <td class="mtxKeyMin">0</td>
<!-- Maximum occurrence: usually 1, * for unbounded -->
  <td class="mtxKeyMax">1</td>
<!-- Item description -->
  <td class="mtxKeyDesc">[** Item definition and comment **]</td>
</tr>

<!-- This is an example comment row -->
<tr class="mtxRule">
  <td class="mtxComment">#</td>
  <td class="mtxComKey">[**...**]</td>
  <td class="mtxComEquals">&nbsp;</td>
  <td class="mtxComValue">&nbsp;</td>
  <td class="mtxKeyMin">0</td>
  <td class="mtxKeyMax">1</td>
  <td class="mtxKeyDesc">[**This is a comment row**]</td>
</tr>
</table>
<hr />
<p><a href="http://validator.w3.org/check/referer"><img
src="http://www.w3.org/Icons/valid-xhtml10.gif" width="88" height="31"
border="0" alt="[Valid XHTML 1.0!]" /></a>
</p>
</body>
</html>
```

Appendix C The Level 1 San Antonio Community Profile

(informative)

An Example of a Community Profile based on the KEV ContextObject Format

(This appendix is not part of *The OpenURL Framework for Context Sensitive Services*, ANSI/NISO Z39.88-2004. It is included for information only.)

C.1 History

NISO Committee AX created the Level 1 San Antonio *Community Profile* (SAP1) to support the deployment of an *OpenURL Framework Application* in the scholarly-information community. SAP1 is built on the *KEV ContextObject Format* and the *OpenURL Transports* specified in Part 4. The *Registry Identifier* of the SAP1 *Community Profile* is **info:ofi/pro:sap1-2004**. The mandatory *XML Document* that defines SAP1 is available at < http://www.openurl.info/registry/docs/pro/info:ofi/pro:sap1-2004 >.

By including the *Inline OpenURL Transport* as a selected core component, SAP1 provides an elegant migration path from the OpenURL 0.1 specification to this Standard. A description of the upgrade process is presented in Appendix A of the Implementation Guidelines for the *KEV ContextObject Format,* available in the *Registry* at <http://openurl.info/registry/docs/implementation_guidelines/>.

C.2 Maintenance of SAP1

NISO Committee AX acts in an advisory capacity until a permanent Maintenance Agency for SAP1 is appointed by NISO. The Maintenance Agency will assume overall responsibility for the further development and maintenance of the SAP1 *Community Profile.*

C.3 Introduction to SAP1

SAP1 consists of those core components of the OpenURL Framework Standard that were selected by NISO Committee AX on behalf of the scholarly-information community. As required by the OpenURL Framework Standard, the selections are entries from the *Registry* for the following components: *Namespaces, Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats,* and *Transports.*

As creator of this Standard, NISO Committee AX also specified the initial content of the *Registry.* Although the initial *Registry* entries are targeted at the scholarly-information community, *Registry* entries used by SAP1 may also be valuable for other communities.

C.4 Purpose and Scope

For the scholarly-information community, the major application of the OpenURL Framework is to provide context-sensitive linking from a reference in online scholarly-information systems to resources and services relevant to the referenced item. Generally, the OpenURL Framework is used as follows:

> When a user clicks a link or button on an HTML page, information about a scholarly resource (a journal article, for example) and about the context in which it is referenced is transported to a linking server. The transportation mechanism is based on HTTP(S) GET or POST, and is referred to as "an OpenURL". The purpose of the transportation is to obtain services relevant to the referenced scholarly resource and its context. The transported descriptions of the referenced item and the context are contained in a *ContextObject Representation.* The *ContextObject* has six possible *Entities,* one of which — the *Referent* — conveys information about the referenced item; the others — the *ReferringEntity, Requester, Resolver, ServiceType,* and *Referrer* — convey information about the context of the reference.

Table 25 shows these six *Entities* together with typical examples from the scholarly-information community. The Table also shows that the *Referent* is mandatory and that the other five *Entities* are optional in the *KEV ContextObject Format,* which is used by SAP1.

Table 25: Use of ContextObject Entities in the Scholarly-Information Community

Entity	Definition	Mandatory Optional	Example
Referent	The *Entity* about which the *ContextObject* was created—a referenced resource	M	A referenced journal article
ReferringEntity	The *Entity* that references the *Referent*	O	A referencing article on EBSCOhost
Requester	The *Entity* that requests services pertaining to the *Referent*	O	The user clicking an OpenURL
ServiceType	The *Entity* that defines the type of service requested	O	Fulltext, ILL, etc.
Resolver	The *Entity* at which a request for services is targeted	O	A library's OpenURL linking server
Referrer	The *Entity* that generated the *ContextObject*	O	EBSCOhost

As specified by this Standard, a *Community Profile* ***must*** list *Registry* selections for the following core components:

- One, and only one, *ContextObject Format.* This choice implies a selection of:
  - A set of constraints on the type and number of *Entities* and *Descriptors* used in *ContextObject Representations*
  - A constraint on the number of *ContextObjects* that ***may*** be represented in an instance document that conforms to the *ContextObject Format*
  - One *Serialization*

  - One *Constraint Language*
  - One or more *Character Encodings*
- *Metadata Formats* that ***may*** be used for *By-Value Metadata* and/or *By-Reference Metadata* descriptions. This choice implies a selection of:
  - One or more *Serializations*
  - One or more *Constraint Languages*
  - One or more *Character Encodings*
- *Namespaces* that ***may*** be used to describe *Entities* with an *Identifier Descriptor.*
- One or more *Transports* that specify how *ContextObject Representations* in the chosen *ContextObject Format* ***must*** be transported.

SAP1 is built around the *KEV ContextObject Format*. It selects *Metadata Formats* and *Namespaces* that meet the needs of the scholarly-information community, and it uses the *OpenURL Transports.* The SAP1 *Community Profile* is identified in the *Registry* as **info:ofi/pro:sap1-2004**.

C.5 Registry Entries in SAP1

The SAP1 *Community Profile* is composed of the registered elements listed in Table 26:

Table 26: SAP1 Registered Elements

Core Component	Registry Entry	Registry Identifier
Namespaces	*Namespace* for “ftp” URI Scheme	**info:ofi/nam:ftp:**
	Namespace for “http” URI Scheme	**info:ofi/nam:http:**
	Namespace for “https” URI Scheme	**info:ofi/nam:https:**
	Namespace for “ldap” URI Scheme	**info:ofi/nam:ldap:**
	Namespace for “mailto” URI Scheme	**info:ofi/nam:mailto:**
	Namespace for “ISBN” URN Namespace	**info:ofi/nam:urn:ISBN:**
	Namespace for “ISSN” URN Namespace	**info:ofi/nam:urn:ISSN:**
	Namespace for “NBN” URN Namespace	**info:ofi/nam:urn:NBN:**
	Namespace for Astrophysics Bibcodes	**info:ofi/nam:info:bibcode:**
	Namespace for Digital Object Identifiers	**info:ofi/nam:info:doi:**
	Namespaces for CNRI Handles	**info:ofi/nam:info:hdl:**
	Namespaces for Library of Congress Control Numbers	**info:ofi/nam:info:lccn:**
	Namespace for OAI Identifiers	**info:ofi/nam:info:oai:**
	Namespace for identifiers assigned by OCLC to records in the WorldCat database	**info:ofi/nam:info:oclcnum:**
	Namespace for PubMed Identifiers	**info:ofi/nam:info:pmid:**

Core Component	Registry Entry	Registry Identifier
	Namespace for identifiers that follow the info:sid scheme, mainly used for the identification of the *Referrer Entity*	**info:ofi/nam:info:sid:**
	Namespace for SICI identifiers	**info:ofi/nam:info:sici:**
Character Encodings	UTF-8 Unicode	**info:ofi/enc:UTF-8**
	ISO Latin 1	**info:ofi/enc:ISO-8859-1**
Serialization	KEV	**info:ofi/fmt:kev**
Constraint Language	Z39.88-2004 Matrix	**info:ofi/fmt:kev:mtx**
ContextObject Format	*KEV ContextObject Format*	**info:ofi/fmt:kev:mtx:ctx**
Metadata Formats	*KEV Metadata Format* for Journals	**info:ofi/fmt:kev:mtx:journal**
	KEV Metadata Format for Books	**info:ofi/fmt:kev:mtx:book**
	KEV Metadata Format for Patents	**info:ofi/fmt:kev:mtx:patent**
	KEV Metadata Format for *ServiceTypes* for the scholarly-information community	**info:ofi/fmt:kev:mtx:sch_svc**
	KEV Metadata Format for Dissertations	**info:ofi/fmt:kev:mtx:dissertation**
Transports	*Inline OpenURL*	**info:ofi/tsp:http:openurl-inline**
	By-Value OpenURL	**info:ofi/tsp:http:openurl-by-val**
	By-Reference OpenURL	**info:ofi/tsp:http:openurl-by-ref**

Appendix D
The Level 2 San Antonio Community Profile

(informative)

An Example of a Community Profile based on the XML ContextObject Format

(This appendix is not part of *The OpenURL Framework for Context Sensitive Services*, ANSI/NISO Z39.88-2004. It is included for information only.)

D.1 History

NISO Committee AX created the Level 2 San Antonio *Community Profile* (SAP2) to support the deployment of an OpenURL Framework Application in the scholarly-information community. SAP2 is built on the *XML ContextObject Format* and the OpenURL *Transports* specified in Part 4. The *Registry Identifier* of the SAP2 *Community Profile* is **info:ofi/pro:sap2-2004**. The mandatory *XML Document* that defines SAP2 is available at
< http://www.openurl.info/registry/docs/pro/info:ofi/pro:sap2-2004 >.

D.2 Maintenance of SAP2

NISO Committee AX acts in an advisory capacity until a permanent Maintenance Agency for SAP2 is appointed by NISO. The Maintenance Agency will assume overall responsibility for the further development and maintenance of the SAP2 *Community Profile.*

D.3 Introduction to SAP2

SAP2 consists of those core components of the OpenURL Framework Standard that were selected by NISO Committee AX on behalf of the scholarly-information community. As required by the OpenURL Framework Standard, the selections are entries from the *Registry* for the following components: *Namespaces, Character Encodings, Serializations, Constraint Languages, ContextObject Formats, Metadata Formats,* and *Transports.*

As creator of this Standard, NISO Committee AX also specified the initial content of the *Registry.* Although the initial *Registry* entries are targeted at the scholarly-information community, *Registry* entries used by SAP2 may also be valuable for other communities.

D.4 Purpose and Scope

For the scholarly-information community, the major application of the OpenURL Framework is to provide context-sensitive linking from a reference in online scholarly information systems to resources and services relevant to the referenced item. Generally, the OpenURL Framework is used as follows:

When a user clicks a link or button on an HTML page, information about a scholarly resource (a journal article, for example) and about the context in which it is referenced is transported to a linking server. The transportation mechanism is based on HTTP(S) GET or POST, and is referred to as "an OpenURL". The purpose of the transportation is to obtain services relevant to the referenced scholarly resource and its context. The transported descriptions of the referenced item and the context are contained in a *ContextObject Representation.* The *ContextObject* has six possible *Entities,* one of which — the *Referent* — conveys information about the referenced item; the others — the *ReferringEntity, Requester, Resolver, ServiceType,* and *Referrer* — convey information about the context of the reference.

Table 27 shows these six *Entities* together with typical examples from the scholarly-information community. The Table also shows that the *Referent* is mandatory and that the other five *Entities* are optional in the *XML ContextObject Format* used by SAP2.

Table 27: Use of ContextObject Entities in the Scholarly-Information Community

Entity	**Definition**	**Mandatory Optional**	**Example**
Referent	The *Entity* about which the *ContextObject* was created—a referenced resource	M	A referenced journal article
ReferringEntity	The *Entity* that references the *Referent*	O	A referencing article on EBSCOhost
Requester	The *Entity* that requests services pertaining to the *Referent*	O	The user clicking an OpenURL
ServiceType	The *Entity* that defines the type of service requested	O	Fulltext, ILL, etc.
Resolver	The *Entity* at which a request for services is targeted	O	A library's OpenURL linking server
Referrer	The *Entity* that generated the *ContextObject*	O	EBSCOhost

As specified by this Standard, a *Community Profile* ***must*** list *Registry* selections for the following core components:

- One, and only one, *ContextObject Format.* This choice implies a selection of:
  - A set of constraints on the type and number of *Entities* and *Descriptors* used for *ContextObject Representations*
  - A constraint on the number of *ContextObjects* that may be represented in an instance document that conforms to the *ContextObject Format*
  - One *Serialization*
  - One *Constraint Language*
  - One or more *Character Encodings*
- *Metadata Formats* that ***may*** be used for *By-Value Metadata* and/or *By-Reference Metadata.* This choice implies a selection of:
  - One or more *Serializations*

  - One or more *Constraint Languages*
  - One or more *Character Encodings*
- *Namespaces* that ***may*** be used to describe *Entities* with an *Identifier Descriptor.*
- One or more *Transports* that specify how *ContextObject Representations* in the chosen *ContextObject Format* ***must*** be transported.

SAP2 is built around the *XML ContextObject Format.* It selects *Metadata Formats* and *Namespaces* that meet the needs of the scholarly-information community and it uses the OpenURL *Transports.* The SAP2 *Community Profile* is identified in the *Registry* as **info:ofi/pro:sap2-2004**.

D.5 Registry Entries in SAP2

The SAP2 *Community Profile* is composed of the registered elements listed in Table 28:

Table 28: SAP2 Registered Elements

Core Component	Registry Entry	Registry Identifier
Namespaces	*Namespace* for "ftp" URI Scheme	**info:ofi/nam:ftp:**
	Namespace for "http" URI Scheme	**info:ofi/nam:http:**
	Namespace for "https" URI Scheme	**info:ofi/nam:https:**
	Namespace for "ldap" URI Scheme	**info:ofi/nam:ldap:**
	Namespace for "mailto" URI Scheme	**info:ofi/nam:mailto:**
	Namespace for "ISBN" URN Namespace	**info:ofi/nam:urn:ISBN:**
	Namespace for "ISSN" URN Namespace	**info:ofi/nam:urn:ISSN:**
	Namespace for "NBN" URN Namespace	**info:ofi/nam:urn:NBN:**
	Namespace for Astrophysics Bibcodes	**info:ofi/nam:info:bibcode:**
	Namespace for Digital Object Identifiers	**info:ofi/nam:info:doi:**
	Namespaces for CNRI Handles	**info:ofi/nam:info:hdl:**
	Namespaces for Library of Congress Control Numbers	**info:ofi/nam:info:lccn:**
	Namespace for OAI Identifiers	**info:ofi/nam:info:oai:**
	Namespace for identifiers assigned by OCLC to records in the WorldCat database	**info:ofi/nam:info:oclcnum:**
	Namespace for PubMed Identifiers	**info:ofi/nam:info:pmid:**
	Namespace for identifiers that follow the **info:sid** scheme, mainly used for the identification of the *Referrer Entity*	**info:ofi/nam:info:sid:**
	Namespace for SICI identifiers	**info:ofi/nam:info:sici:**
Character Encodings	UTF-8 Unicode	**info:ofi/enc:UTF-8**
Serialization	W3C XML 1.0	**info:ofi/fmt:xml**

Core Component	**Registry Entry**	**Registry Identifier**
Constraint Language	W3C XML Schema	**info:ofi/fmt:xml:xsd**
ContextObject Format	*XML ContextObject Format*	**info:ofi/fmt:xml:xsd:ctx**
Metadata Formats	*XML Metadata Format* for Journals	**info:ofi/fmt:xml:xsd:journal**
	XML Metadata Format for Books	**info:ofi/fmt:xml:xsd:book**
	XML Metadata Format for Patents	**info:ofi/fmt:xml:xsd:patent**
	XML Metadata Format for *ServiceTypes* for the scholarly-information community	**info:ofi/fmt:xml:xsd:sch_svc**
	XML Metadata Format for Dissertations	**info:ofi/fmt:xml:xsd:dissertation**
Transports	By-Value OpenURL	**info:ofi/tsp:http:openurl-by-val**
	By-Reference OpenURL	**info:ofi/tsp:http:openurl-by-ref**

Appendix E
Implementation Guidelines for the OpenURL Transports

(informative)

(This appendix is not part of *The OpenURL Framework for Context Sensitive Services*, ANSI/NISO Z39.88-2004. It is included for information only.)

E.1 Length of HTTP(S) GET URIs

Transport techniques based on HTTP(S) GET are subject to length limitations on the GET URI. The OpenURL Standard does not place any a priori limit on the length of an OpenURL. However, *Resolvers* ***must*** be able to accept OpenURLs as long as 255 bytes after encoding and ***should*** be able to accept OpenURLs as long as 2048 bytes.

E.2 URL-Encoding and URL-Decoding

URL-encoding and decoding of HTTP(S) GET and POST query string values prevent the misinterpretation of special characters occurring in these values.

To form an encoded value from a value, a procedure called URL-encoding is used:

1. The alphanumeric characters 'a' through 'z', 'A' through 'Z', and '0' through '9' remain unchanged.
2. The period character ('.'), the hyphen character ('-'), the asterisk character ('*'), and the underscore character ('_') remain unchanged.
3. The space character (' ') is replaced with a plus-sign character ('+') or with the character string "%20".
4. All other characters (the unsafe characters) are first converted into one or more bytes using the UTF-8 encoding method (or another encoding if specified by the *ContextObject Format*). Then, each byte is represented by the 3-byte string "%XY", where XY is the two-digit hexadecimal representation of the byte.

To form a value from an encoded value, a procedure called URL-decoding is used. It reverses the URL-encoding procedure:

1. The plus-sign character ('+') is replaced by the space character (' ').
2. Each instance of a three-byte string "%XY", where XY is a hexadecimal number, is replaced with the corresponding byte.
3. The bytes are converted to Unicode characters using UTF-8, unless otherwise specified by a *ContextObject Format.*

E.3 Parsing of HTTP(S) Query Strings

Upon receiving an OpenURL request, the *Resolver* may parse and URL-decode the query string into a set of KEV pairs. Depending on the type of *Transport,* a *Resolver* may encounter three types of keys: OpenURL keys, *KEV ContextObject* keys, and foreign keys.

1. All *OpenURL Transports* use OpenURL keys. They are defined in Sections 20.1, 21.1, and 22.1. All OpenURL keys share the prefix **url_**.

2. In addition to the OpenURL keys, the *Inline OpenURL Transport* also uses keys from the *KEV ContextObject Format.* These keys are defined in Section 13.2. They are:
   - Administrative keys (prefixed by **ctx_**).
   - *Entity* keys (prefixed by **rft_**, **rfe_**, **req_**, **rfr_**, **res_**, or **svc_**).
   - Keys from *KEV Metadata Formats* (prefixed by **rft.**, **rfe.**, **req.**, **rfr.**, **res.**, or **svc.**).
3. All Transports ***may*** use foreign keys. Foreign keys are keys that do not reside under the categories specified by 1 and 2 above. The OpenURL Transports do not define their meaning.