Network Working Group
Internet-Draft
Expires: January 11, 2005

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July 13, 2004

IRIS - The Internet Registry Information Service (IRIS) Core Protocol
draft-ietf-crisp-iris-core-07

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Abstract

This document describes an application layer client-server protocol for a framework of representing the query and result operations of the information services of Internet registries. Specified in XML, the protocol defines generic query and result operations and a mechanism for extending these operations for specific registry service needs.

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1. Introduction

The specification outlined in this document is based on the functional requirements described in CRISP [17].

1.1 Use of XML

This document describes the specification for the Internet Registry Information Service (IRIS), an XML text protocol with the purpose of describing the query types and result types of various registry information services. IRIS is specified using the Extensible Markup Language (XML) 1.0 as described in [2], XML Schema notation as described in [4] and [5], and XML Namespaces as described in [3].

1.2 General Concepts

Each kind of Internet registry is identified by a registry type. The identifier for a registry type is a Uniform Resource Name (URN) used within the XML instances to identify the XML schema formally describing the set of queries, results, and entity classes allowed within that type of registry.

The structure of these URNs makes no assumptions or restrictions on the type of registries they identify. Therefore, IRIS may support multiple registry types of disparate or similar nature; it is only a matter of definition. For instance, a single registry type may be defined for domain name registries while multiple registry types may be defined for the various IP address registries.

A registry information server may handle queries and serve results for multiple registry types. Each registry type that a particular registry operator serves is a registry service instance.

IRIS and the XML schema formally describing IRIS do not specify any registry, registry identifier, or knowledge of a particular service instance or set of instances. IRIS is a specification for a framework with which these registries can be defined, used, and in some cases interoperate. The framework merely specifies the elements for registry identification and the elements which must be used to derive queries and results.

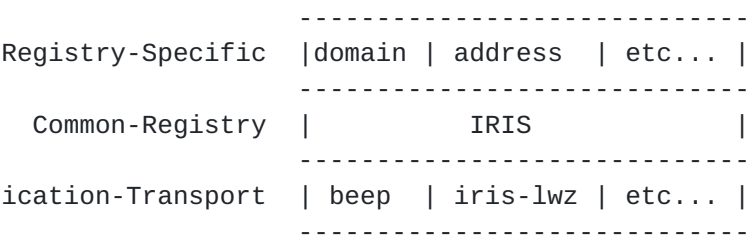
This framework allows a registry type to define its own structure for naming, entities, queries, etc. through the use of XML namespaces and XML schemas (hence, a registry type MUST be identified by the same URI that identifies its XML namespace). In order to be compliant, a registry type's specification must extend from this framework.

The framework does define certain structures that can be common to all registry types, such as references to entities, search continuations, entity classes, and more. A registry type may declare its own definitions for all of these, or it may mix its derived definitions with the base definitions.

IRIS defines two types of referrals, an entity reference and a search continuation. An entity reference indicates specific knowledge about an individual entity, and a search continuation allows for distributed searches. Both referrals may span differing registry types and instances. No assumptions or specifications are made about roots, bases, or meshes of entities.

1.3 Framework Layers

The IRIS framework can conceptually be thought of as having three layers.



In this figure, "beep" refers to the Blocks Extensible Exchange Protocol (BEEP) (see [20]) and "iris-lwz" refers to a theoritical UDP binding using compression.

The differing layers have the following responsibilities:

Registry-Specific :: Defines queries, results, and entity classes of a specific type of registry. Each specific type of registry is identified by a URN.

Common-Registry :: Defines base operations and semantics common to all registry types such as search sets, result sets, referrals, etc. It also defines the syntaxes for talking about specific registry types.

Application-Transport :: Defines the mechanisms for authentication, message passing, connection and session management, etc. It also defines the URI syntax specific to the application-transport mechanism.

1.4 Definitions

For clarity, the following definitions are supplied:

- registry type - A registry serving a specific function, such as a domain registry or an address registry. Each type of registry is assigned a URN.

- registry schema - The definition for a registry type specifying the queries, results, and entity classes.
- authority - A reference to the server or set of servers containing information.
- resolution method - The technique used to locate an authority.
- entity class - A group of entities with a common type or common set of characteristics.
- entity name - The identifier used to refer to a single entity within an entity class.
- entity reference - A pointer to an entity composed of an authority, an optional resolution method, a registry type, an entity class, and an entity name. One type of entity reference is the IRIS URI (defined in Section 7).

The terms "derivative", "derive", and "derivation" are used with the same meaning for deriving one type of element from another as specified in XML_SS [5].

1.5 Further Reading

Appendix B contains text answering the question, "Why IRIS?"

This document describes the structure at the core of IRIS. The following documents describe the other aspects of IRIS relevant to CRISP [17]: iris-beep [1], and iris-dreg [18].

2. Document Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC2119 [8].

3. Protocol Identification

The root element of all request XML instances MUST be <request>. The root element of all response XML instances MUST be <response>. These elements identify the start of the IRIS elements, the XML namespace used as the identifier for IRIS, and optionally the location of the schema. These elements and the associated closing tag MUST be applied to all requests and responses sent by both clients and servers.

The use of the schema location attribute, 'xsi:schemaLocation', is OPTIONAL with respect to this specification, and IRIS implementations MAY resolve it to retrieve the schema or they MAY use a locally cached version of the schema.

Versioning of the IRIS protocol is the responsibility of the application-transport layer but MUST be associated with the XML namespace [3] URI representing IRIS. A change in this URI indicates a change of the underlying schema and therefore a new version of the protocol (and vice versa).

4. Exchange Description

This section describes the request and response exchanges of the protocol. The descriptions contained within this section refer to XML elements and attributes and their relation to the exchange of data within the protocol. These descriptions also contain specifications outside the scope of the formal XML syntax. Therefore, this section will use terms defined by RFC 2119 [8] to describe the specification outside the scope of the formal XML syntax. While reading this section, please reference Section 6 for needed details on the formal XML syntax.

4.1 Request Format

A <request> element contains an optional <control> element and a set of <searchSet> elements.

The <searchSet> elements enables a client to query a particular registry type using the URN identifying the registry type. This can be found in one of its two children: <lookupEntity> and <query>.

The <lookupEntity> element describes the lookup of an entity in a specific registry. This element has three attributes: 'registryType', 'entityClass', and 'entityName'. The 'registryType' attribute contains the registry identifier for the registry type in which the lookup operation is to take place. The 'entityClass' attribute contains the token identifying the index for which the lookup operation is to take place, and the 'entityName' attribute contains the name of the entity to lookup.

The <query> element is abstract and may not legally appear in an XML instance. It provides the base type to be used by registry schemas to define derived query types. This derivation mechanism is described in Section 4.3.

Each <searchSet> may also contain a <bag> element. When this element appears as a child of <searchSet>, it MUST NOT contain the 'id' attribute. For a description of the <bag> element, see Section 4.4.

The <control> element may contain one child element of any XML namespace. This child element allows a client to signal to a server the desire for special states or processing. An example of one such <control> child element may be found in Section 4.3.8.

4.2 Response Format

The <response> element contains an optional <reaction> element, a set of <resultSet> elements, and an optional <bags> element.

The <resultSet> elements are responses to a <searchSet> request. The contents of this element contain an <answer> element, an optional <additional> element, and error elements if applicable.

The children of the <answer> element are of the following types:

- <result> is an abstract element and may not be legally placed in an XML instance. It provides the base type to be used by registry schemas to define derived result types. This derivation mechanism is described in Section 4.3.
- <entity> is an element specifying an entity reference. See Section 4.3.5.
- The <searchContinuation> element specifies a query referral. Its one child is any element derived from <query> (See Section 4.3.1). To direct the query to a referent server, <searchContinuation> has a mandatory 'authority' attribute and an optional 'resolution' attribute. The <searchContinuation> element may also contain a 'bagRef' attribute. For a description of the 'bagRef' attribute, see Section 4.4.

When following entity references and search continuations, clients SHOULD only follow an <entity> or <searchContinuation> response once. Failure to do so may result in the client process getting stuck in a never-ending query loop commonly known as a referral loop.

The <additional> element only contains <result> elements, as described above. This element is provided to allow a server to indicate to a client results that were not specifically queried but are related to the queried results, thus allowing the client the ability to properly display this distinction to a user. The <additional> element use is optional.

The following elements, representing error conditions, may be returned:

- <insufficientResources> - the corresponding query requires resources unobtainable by the server.
- <invalidName> - a name given in a query is not syntactically correct.
- <invalidSearch> - parameters of the corresponding query are not semantically meaningful.
- <queryNotSupported> - the corresponding query is not supported by this server.
- <limitExceeded> - the corresponding query requires more resources than allowed.
- <nameNotFound> - the name given in a query does not match a known entity.
- <permissionDenied> - the authentication given does not allow access to a specific result entry.

- <bagUnrecognized> - the contents of a bag were unrecognized. See Section 4.4.
- <bagUnacceptable> - the contents of a bag were not and never will be acceptable. See Section 4.4.
- <bagRefused> - the contents of a bag were not acceptable at this time. See Section 4.4.
- A derivative of <genericCode>, as described in Section 4.3.

The <resultSet> section is divided up into the <answer> and <additional> sections in order to allow easier processing and navigation of the results by a client. Servers MUST return the direct answers to queries in the <answer> element, and MAY return results in the <additional> element for which a reference has been made to in the <answer> element. Results in the <additional> element MUST have been referenced in the <answer> either as direct children of the <answer> element or as a deeper descendant of the <answer> element.

This serves two purposes. First, it may eliminate a requery by the client for references contained in the <answer> element. Second, it distinguishes between results that are a direct result of a query and those that would have been returned had the client followed the appropriate referrals, thus giving clients a hint as to how to process or display the returned results. For instance, clients constructing complex displays using tree navigation widgets will know that results in the <answer> element should all be directly beneath the root node of the tree, while results in the <additional> element are to be leaf nodes of those produced from the <answer> element.

A <reaction> element (child of <response>) is a response to a <control> element, and provide a means for a server to advise a client of the affect of a <control> element.

The <bags> element (child of <response>) is optional. It contains <bag> elements, and the contents of each <bag> element is one element in any XML namespace. Each <bag> element has an 'id' attribute, which is referenced by the 'bagRef' attribute of entity references (<entity>) and search continuations (<searchContinuation>). See Section 4.4.

4.3 Extension Framework

Because the IRIS schema defines only one query type, no registry structure, and only two stand-alone result types, it is of limited use by itself. Extension of IRIS is accomplished through the use a base IRIS schema, as defined in XML_SD [4] and XML_SS [5], and extension of it by schemas constructed on top of IRIS.

4.3.1 Derived Elements

The XML Schema definition of IRIS requires schemas of registry types to derive element types from base types in the IRIS definition. The registry schemas MUST derive elements for definition of typed queries and results.

While the IRIS schema definition does not prohibit the derivation of any elements, registry schemas SHOULD restrict the derivations to the following types:

- <query> - as defined this element contains no content and has no valid attributes. It is abstract and therefore only derivatives of it appear in XML instances. Registry schemas derive from this element to define the queries allowed.
- <result> - as defined this element contains no content and has five valid attributes: 'authority', 'resolution' (optional), 'registryType', 'entityClass' 'entityName', and 'temporaryReference' (optional, see Section 4.3.6). It is abstract and therefore only derivatives of it appear in XML instances. Registry schemas derive from this element to define results that may be returned from a query.
- <genericCode> - as defined, this element is an instance of <codeType>. It contains the optional elements <explanation> and <language> to further describe the nature of the error.
- <entity> - identifies a reference to an entity. Registry schemas SHOULD use elements derived from <entity>, but MAY use <entity> directly. The advantage of deriving from <entity> vs. using it directly is the chance to define the name of the element and to use that name descriptively, for instance, as the role which the entity plays with respect to another entity. See Section 4.3.5.
- <seeAlso> - indicates a reference to an entity that has indirect association with a parent element representing an entity. This element is derived from the <entity> (Section 4.3.5) element. Registry schemas MAY derive from this element or MAY use it directly.

4.3.2 Registry Type Identifier Requirements

The identifier for a registry type and the XML namespace identifier used by the XML Schema describing the registry MUST be the same. These identifiers MUST be restricted to a URN [7] registered in the 'ns' class of the IANA registry governed by XML_URN [9]. These identifiers are case insensitive.

This is a restriction on XML_NS [3], which specifies an XML namespace identifier is any valid URI [6].

These identifiers MAY be abbreviated to the part following the class

component and its separator of the URN. For example, the full URN "urn:ietf:params:xml:ns:dreg1" may be abbreviated to "dreg1".

This abbreviation MUST NOT be used inside of XML instances in use with IRIS where XML Schema [4] specifies the use of a URI for schema identification or where XML_NS [3] specifies the use of a URI for XML namespace identification.

4.3.3 Entity Classes

Entity classes are provided in IRIS to help avoid collisions with entity names within any given registry type. Their specification in queries also allows server implementations to quickly narrow search or lookup scopes to a single index.

For instance, the entity name "192.0.2.0" might refer to separate entities in the "name-server" and "network" classes. The entity "192.0.2.0" in the "name-server" class may refer to the name server host that is also multi-homed by address 192.0.2.255 and known in DNS as "ns.example.com", whereas the entity "192.0.2.0" in the "network" class may refer to the network 192.0.2/30.

IRIS defines two default entity classes of "local" and "iris" which MUST NOT be redefined. These entity classes MUST be valid in all registry types.

The "local" class is reserved for entities defined locally by a server operator and does not denote any particular type of entity. A lookup in this entity class MAY result in an entity reference or search continuation. For example, "iris:dreg1//example.com/local/myhosts" may result in a search continuation yielding the nameservers for example.com.

The "iris" class is reserved for entities specific to a particular service instance. It MUST contain the following entity names (see Section 4.3.4:

- "id" which yields a result of <serviceIdentification> (see Section 4.3.7.1).
- "limits" which yields a result of <limits> (see Section 4.3.7.2).

This entity class MAY contain other locally defined entities as well.

The names of entity classes in a registry schema are of type token defined by XML_SD [4]. Their case sensitivity MUST be defined by the definition of the registry type. In general, they SHOULD be case insensitive.

4.3.4 Names of Entities

The names of entities in a registry schema are of type token defined by XML_SD [4].

Names of entities SHOULD be unique within an instance of any particular entity class within a registry. Two entities SHOULD NOT have the same name, but a single entity MAY be known by multiple names. In situations where a single name may result in two entities, the registry schema SHOULD make allowances by defining result types that contain entity references to both entities (i.e. "example.com" can refer to both the domain example.com and the host example.com). However, this type of conflict SHOULD generally be avoided by the proper use of entity classes.

The case sensitivity of entity names is dependent on the entity class in which they reside. The definition of a registry type MUST specify the case sensitivity for entity names. A registry type MAY define the entity names of differing entity classes to have different case sensitivity.

4.3.5 References to Entities

The element <entity> allows references to entities in result sets, either as a direct child of <resultSet> or within a more complex structure that derives from <result>. The <entity> element is defined by 'entityType'. Registry schemas SHOULD define elements derived from <entity> when referencing entities but may use the <entity> element directly. Deriving a new element allows a registry schema to use the name of the new element as a role signifying the relationship the referenced entity has with the referrer. A derivative of <entity> MUST NOT be used as a substitute when the <entity> element is declared (such as in the <answer> section of the <resultSet>).

The <entity> element (and elements of type 'entityType') can have child elements of <displayName> with an optional 'language' attribute. These are provided so that servers may provide to clients a more human friendly meaning to the entity reference. This is often useful to users navigating referral structures.

The <entity> element (and its derivations) have the following attributes:

- 'authority', 'resolution' (optional), 'registryType', 'entityClass', and 'entityName' - these attributes specify where the entity may be found.
- 'temporaryReference' - this attribute is optional. See Section 4.3.6.

- o 'referentType' - this attribute contains the expected type of the entity being referenced and may contain the word "ANY" or a qualified XML name. Unlike the other attributes of <entity>, this attributed is qualified and declared in the IRIS XML namespace. Therefore it will also be qualified with the prefix associated with the IRIS XML namespace (e.g. 'iris:referentType'). This allows clients to recognize entity references using an element derived from <entity>.
- o 'bagRef' - this attribute is optional. If present, this attribute must contain an XML identifier to a <bag> element in the <bags> section of the result set. For a description of the 'bagRef' attribute, see Section 4.4.

4.3.6 Temporary Entities

There may exist instances where an entity reference needs to be temporary. As an example, a particular type of result may only have one unique key. If that key contained semantic meaning that may not be exposed to all users, a synthetic key will need to be substituted.

As an additional example, there may be times when data in the data store is not normalized in the same manner as that expressed by the registry schema. In the registry schema, objects of type A may reference objects of type B. But in the data store, objects of type A may contain objects of type B. Again, a synthetic key will need to be temporarily produced.

To support such use cases, results and entity references can be declared temporary by using the 'temporaryReference' attribute. This attribute is of type boolean [4] and has a default value of "false". It is optional for <result> derivatives and elements of type 'entityType'.

When this attribute is used, the entity reference data (i.e., 'entityClass', 'entityName', etc.) is only valid within the response in which it appears and may not be consistent with subsequent responses. A server MUST include the referent of any temporary entity reference in the <additional> section of the same <resultSet>

4.3.7 <result> Derived Elements

The base IRIS framework does contain three elements directly derived from the <result> element for use by any registry type.

4.3.7.1 <serviceIdentification>

An example of an <serviceIdentification> result:

```
<serviceIdentification
  authority="example.com" registryType="dreg1"
  entityClass="iris"
  entityName="id" >
  <authorities>
    <authority> example.com </authority>
    <authority> example.net </authority>
    <authority> example.org </authority>
  </authorities>
  <operatorName>
    Ineternet Assigned Numbers Authority
  </operatorName>
  <eMail>
    iana@iana.org
  </eMail>
</serviceIdentification>
```

The <serviceIdentification> element is provided to allow IRIS clients the ability to reference IRIS service instances. It contains the following elements:

- <authorities> - This element contains one or more <authority> elements. Each <authority> element contains a URI authority component for which the server has results. While a server MAY only return a partial list of its authority areas depending on operator policy, it MUST return the authority for which the client has requested.
- <operatorName> - This element contains the name of the operator of the server.
- <eMail> - These optional elements contain email addresses of the operator of the service instance.
- <phone> - These optional elements contain phone numbers of the operator of the service instance.
- <seeAlso> - See Section 4.3.1 for its definition.

4.3.7.2 <limits>

An example of a <limits> result:

```
<limits
  authority="example.com" registryType="dreg1"
  entityClass="iris" entityName="limits">
  <totalQueries>
    <perHour>2</perHour>
    <perDay>15</perDay>
  </totalQueries>
  <totalResults>
    <perHour>25</perHour>
    <perDay>200</perDay>
  </totalResults>
  <totalSessions>
    <perHour>2</perHour>
    <perDay>15</perDay>
  </totalSessions>
</limits>
```

The <limits> element provides a mechanism to allow a server to inform a client of the limits it may encounter from over use of the service. The contents describe the service limitations to a client at the current level of access. The contents of this element are as follows:

- <totalQueries> - This element describes the total number of queries that the server will accept. The children of this element indicate this number per a unit of time. The children are <perSecond>, <perMinute>, <perHour>, and <perDay>. Each child MUST only appear once as a child of <totalQueries>, but more than one child MAY be present. For example, a server could indicate that it will accept 15 queries a minute but only 60 queries a day.
- <totalResults> - This element describes the total number of results that the server will send to a client. The children of this element indicate this number per unit of time in the same manner as <totalQueries>.
- <totalSessions> - This element describes the total number of sessions that the server will accept from a client. The children of this element indicate this number per unit of time in the same manner as <totalQueries>. The definition of a session is defined the by application transport layer.
- <otherRestrictions> - This element describes other restrictions that may only be expressible outside of the structured syntax of the other child elements of <limits>. This element may have optional <description> child elements, each with a mandatory 'language' attribute.
- <seeAlso> - These elements are provided to reference other entities, such as a <simpleEntity> (Section 4.3.7.3) describing a published policy. See <seeAlso> (Section 4.3.1).

All of these child elements are optional, and a server may express

that it has no limits by using a <limits> element with no content (e.g. <limits authority=... />).

4.3.7.3 <simpleEntity>

An example of a <simpleEntity> result:

```
<simpleEntity
  authority="example.com" registryType="dreg1"
  entityClass="local"
  entityName="notice" >
  <property name="legal" language="en">
    Example.com is reserved according to RFC 2606.
  </property>
</simpleEntity>
```

The <simpleEntity> element is provided so that service operators may make simple additions to other entities without the need for deriving entirely new registry types. Its definition allows service operators to reference it from other entities (using, for instance, a <seeAlso> element). The <simpleEntity> is meant to represent name and value pairs of strings, allowing each pair to be associated with a specific language qualifier, and optional URI pointing to more information.

Clients may easily display such information as a two-column table. Uses needing binary data or richer data structures are out of scope for this element. When such usage scenarios arise, it is likely that a client will need specific knowledge for handling such data thus calling into question the need for a new registry type.

4.3.8 <control> and <reaction> Elements

The <control> (Section 4.1) and <reaction> (Section 4.2) elements allow the client to request from the server special states for the processing of queries. The intent of these elements is to allow extensibility so that some jurisdictions may adopt policies for query processing without requiring re-versioning of IRIS or any registry type.

This document defines one control, <onlyCheckPermissions> and its requisite reaction, <standardReaction>, for compliance with CRISP [17].

When a client sends an <onlyCheckPermissions> control, it is asking the server to only check to see if adequate permissions are available to execute the queries in the associated request. A server MUST respond to this control with a <standardReaction> element.

The <standardReaction> element provides a server with a standard means to respond to controls (it may be used by other controls, but that is left to their definition). It contains four children:

- <controlAccepted> - the processing or state needed by the control has been accepted.
- <controlDenied> - the processing or state needed by the control has been denied (a transient failure).
- <controlDisabled> - the processing or state needed by the control cannot be activated (a permanent failure).
- <controlUnrecognized> - the control is not recognized (a permanent failure).

If <onlyCheckPermissions> is rejected, then the server MUST return all appropriate result sets (i.e. for every search set in the request), but all result sets MUST be empty of results and MUST contain no errors (a reaction is not part of a result set and is therefore not a result set error). This control applies to all search sets or none at all, therefore a server MUST issue a rejection if <onlyCheckPermissions> cannot be accepted for all search sets in a request.

An example of an IRIS XML exchange using these elements:

```
C: <?xml version="1.0"?>
C: <request xmlns="urn:ietf:params:xml:ns:iris1"
C:   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" >
C:
C:   <control>
C:     <onlyCheckPermissions />
C:   </control>
C:
C:   <searchSet>
C:
C:     <lookupEntity
C:       registryType="dreg1"
C:       entityClass="local"
C:       entityName="AUP" />
C:
C:   </searchSet>
C:
C: </request>

S: <?xml version="1.0"?>
S: <response xmlns="urn:ietf:params:xml:ns:iris1"
S:           xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" >
S:
S:   <reaction>
S:     <standardReaction>
S:       <controlAccepted />
```

```
S:     </standardReaction>
S:   </reaction>
S:
S:   <resultSet>
S:     <answer>
S:
S:       <simpleEntity
S:         authority="example.com" registryType="dreg1"
S:         entityClass="local" entityName="AUP" >
S:         <property name="legal" language="en">
S:           It is illegal to use information from this service
S:           for the purposes of sending unsolicited bulk email.
S:         </property>
S:       </simpleEntity>
S:
S:     </answer>
S:   </resultSet>
S:
S: </response>
```

4.4 Relay Bags

IRIS employs the use of bags to allow a server to relay information to a referent server via the client. These bags are generated by the queried server, passed to the client as opaque data, and then passed to the referent server for processing. The contents of the bags are not defined by IRIS, and the client MUST NOT make any assumptions about the contents of a bag when relaying it from one server to another.

When a server returns a result set to a client, the <response> element may contain a <bags> child element. This child element contains one or more <bag> elements. Each of these MUST contain an 'id' attribute containing the XML data type ID. Entity references and search continuations that need to specify a bag to be used when they are followed MUST have a 'bagRef' attribute containing the XML data type IDREF. See Section 4.2. This allows the response to only specify a bag once but allows each entity reference or search continuation (in all result sets) to have a distinct bag as needed.

When following an entity reference or search continuation that specifies the use of a bag, the client MUST include the referenced bag in the search set as a child of the <searchSet> element. See Section 4.1.

See Section 4.2 for the list of errors a server may return to a client when a bag is received. A server MUST NOT ignore a bag when

it is received. In case that a bag cannot be recognized or accepted, one of the errors from Section 4.2 MUST be returned.

An example of an IRIS XML exchange using these elements:

```
C: <?xml version="1.0"?>
C: <request xmlns="urn:ietf:params:xml:ns:iris1"
C:   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" >
C:
C:   <searchSet>
C:
C:     <bag>
C:       <simpleBag xmlns="http://example.com/">
C:         XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
C:       </simpleBag>
C:     </bag>
C:
C:     <lookupEntity
C:       registryType="dreg1"
C:       entityClass="local"
C:       entityName="AUP" />
C:
C:   </searchSet>
C:
C: </request>

S: <?xml version="1.0"?>
S: <response xmlns="urn:ietf:params:xml:ns:iris1"
S:           xmlns:iris="urn:ietf:params:xml:ns:iris1"
S:           xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" >
S:
S:   <resultSet>
S:     <answer>
S:
S:       <entity authority="example.com" bagRef="x1"
S:         registryType="dreg1"
S:         entityClass="local" entityName="AUP"
S:         iris:referentType="ANY" >
S:         <displayName language="en">
S:           Acceptable Usage Policy
S:         </displayName>
S:       </entity>
S:
S:     </answer>
S:   </resultSet>
S:
S:   <bags>
S:
```

```
S:     <bag id="x1">
S:       <simpleBag xmlns="http://example.com/">
S:         AAAAB3NzaC1yc2EAAAABIwAAAIEA0ddD+W3Agl0Lel98G1r77fZ
S:       </simpleBag>
S:     </bag>
S:
S:   </bags>
S: </response>
```

5. Database Serialization

This section describes a method for serializing IRIS registry entities. The descriptions contained within this section refer to XML elements and attributes and their relation to this serialization process. These descriptions also contain specifications outside the scope of the formal XML syntax. Therefore, this section will use terms defined by RFC 2119 [8] to describe the specification outside the scope of the formal XML syntax. While reading this section, please reference Section 6 for needed details on the formal XML syntax.

A database of IRIS entities can be serialized to file storage with XML [2] using the IRIS defined <serialization> element. This element contains <result> element derivatives, and <serializedReferral> elements.

Derivatives of the <result> element are entities. Servers loading these entities MUST place the entity in the entity class specified by the elements 'registryType', 'entityClass', and 'entityName' attributes and any entity class which the entity may apply according to explicitly defined children of that element. For instance, if a registry type has two entity classes of "foo" and "bar" and a <result> derivative has the attributes entityClass="foo" and entityName="one" and a child element <bar>two</bar>, the server is to enter that entity into the entity class "foo" as the name "one" and into the entity class "bar" as the name "two".

Servers loading entities as serialized derivatives of the <result> element MAY translate the authority attribute. Servers will likely need to do this if the authority for the entity has changed.

<serializedReferral> elements allow the serialization of explicit entity references and search continuations. This element has a child <source> element, containing the 'authority', 'resolution' (optional), 'registryType', 'entityClass', and 'entityName' attributes. The attributes of this element are to be used to signify the entity which can be referenced to yield this referral.

As mentioned above, there may be times when a server needs to translate the authority attribute of a loaded entity. Implementations must also beware of this need for referrals. During deserialization, servers MUST change the authority attribute of a referral (either <entity> or elements derived from <entity> or <source> child of <serializedReferral>) to contain a valid authority of the server if the serialized attribute is empty. During serialization, servers and their related processes MUST leave the authority attribute empty for referrals in which the referent is an

entity for which the server answers queries.

The following is an example of serialized IRIS.

```
<iris:serialization
  xmlns:iris="urn:ietf:params:xml:ns:iris1"
  xmlns="urn:ietf:params:xml:ns:iris1"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

  <serviceIdentification
    authority="iana.org" registryType="dreg1"
    entityClass="iris"
    entityName="id" >
    <authorities>
      <authority> iana.org </authority>
    </authorities>
    <operatorName>
      Internet Assigned Numbers Authority
    </operatorName>
    <eMail>
      dbarton@iana.org
    </eMail>
    <seeAlso
      iris:referentType="iris:simpleEntity"
      authority="iana.org" registryType="dreg1"
      entityClass="local"
      entityName="notice">
      <displayName language="en">
        Legal Notice
      </displayName>
    </seeAlso>
  </serviceIdentification>

  <serializedReferral>
    <source
      authority="example.com" registryType="dreg1"
      entityClass="iris"
      entityName="id"/>
    <entity
      iris:referentType="iris:serviceIdentification"
      authority="iana.org" registryType="dreg1"
      entityClass="iris" entityName="id"/>
  </serializedReferral>

  <simpleEntity
    authority="iana.org" registryType="dreg1"
    entityClass="local"
```

```
       entityName="notice" >
       <property name="legal" language="en">
         Please use the net wisely!
       </property>
     </simpleEntity>

   </iris:serialization>
```

6. Formal XML Syntax

IRIS is specified in XML Schema notation. The formal syntax presented here is a complete schema representation of IRIS suitable for automated validation of IRIS XML instances.

```
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
        xmlns:iris="urn:ietf:params:xml:ns:iris1"
        targetNamespace="urn:ietf:params:xml:ns:iris1"
        elementFormDefault="qualified" >

  <annotation>
    <documentation>
      Internet Registry Information Service (IRIS) Schema v1
    </documentation>
  </annotation>

  <!-- ========================================= -->
  <!--                                           -->
  <!-- The Transactions                          -->
  <!--                                           -->
  <!-- ========================================= -->

  <element name="request">
    <complexType>
      <sequence>
        <element
          name="control"
          type="iris:controlType"
          minOccurs="0"
          maxOccurs="1" />
        <element
          name="searchSet"
          type="iris:searchSetType"
          minOccurs="1"
          maxOccurs="unbounded" />
      </sequence>
    </complexType>
  </element>

  <element name="response">
    <complexType>
      <sequence>
        <element
          name="reaction"
          type="iris:reactionType"
```

```
            minOccurs="0"
            maxOccurs="1" />
          <element
            name="resultSet"
            type="iris:resultSetType"
            minOccurs="1"
            maxOccurs="unbounded" />
          <element
            name="bags"
            type="iris:bagsType"
            minOccurs="0"
            maxOccurs="1" />
      </sequence>
    </complexType>
  </element>

  <!-- ======================================== -->
  <!--                                          -->
  <!-- Search Sets and Result Sets              -->
  <!--                                          -->
  <!-- ======================================== -->

  <complexType
    name="searchSetType" >
    <sequence>
      <element
        name="bag"
        type="iris:bagType"
        minOccurs="0"
        maxOccurs="1" />
      <choice>
        <element
          name="lookupEntity"
          type="iris:lookupEntityType" />
        <element
          ref="iris:query" />
      </choice>
    </sequence>
  </complexType>

  <complexType
    name="resultSetType" >
    <sequence>
      <element
        name="answer"
        minOccurs="1"
        maxOccurs="1">
        <complexType>
```

```
            <sequence>
              <element
                ref="iris:result"
                minOccurs="0"
                maxOccurs="unbounded" />
              <element
                ref="iris:entity"
                minOccurs="0"
                maxOccurs="unbounded" />
              <element
                ref="iris:searchContinuation"
                minOccurs="0"
                maxOccurs="unbounded" />
            </sequence>
          </complexType>
        </element>
        <element
          name="additional"
          minOccurs="0"
          maxOccurs="1">
          <complexType>
            <sequence>
              <element
                ref="iris:result"
                minOccurs="1"
                maxOccurs="unbounded" />
            </sequence>
          </complexType>
        </element>
        <choice
          minOccurs="0"
          maxOccurs="1" >
          <element
            name="insufficientResources"
            type="iris:codeType" />
          <element
            name="invalidName"
            type="iris:codeType" />
          <element
            name="invalidSearch"
            type="iris:codeType" />
          <element
            name="queryNotSupported"
            type="iris:codeType" />
          <element
            name="limitExceeded"
            type="iris:codeType" />
          <element
```

```
            name="nameNotFound"
            type="iris:codeType" />
          <element
            name="permissionDenied"
            type="iris:codeType" />
          <element
            name="bagUnrecognized"
            type="iris:codeType" />
          <element
            name="bagUnacceptable"
            type="iris:codeType" />
          <element
            name="bagRefused"
            type="iris:codeType" />
          <element
            ref="iris:genericCode"/>
        </choice>
      </sequence>
    </complexType>

    <!-- ======================================== -->
    <!--                                          -->
    <!-- Controls and Reactions                   -->
    <!--                                          -->
    <!-- ======================================== -->

    <complexType
      name="controlType">
      <sequence>
        <any
          namespace="##any"
          processContents="skip"
          minOccurs="1"
          maxOccurs="1" />
      </sequence>
    </complexType>

    <complexType
      name="reactionType">
      <sequence>
        <any
          namespace="##any"
          processContents="skip"
          minOccurs="1"
          maxOccurs="1" />
      </sequence>
    </complexType>
```

```
    <!-- ======================================== -->
    <!--                                          -->
    <!-- Queries and Lookups                      -->
    <!--                                          -->
    <!-- ======================================== -->

    <complexType
      name="queryType" />

    <element
      name="query"
      type="iris:queryType"
      abstract="true" />

    <complexType
      name="lookupEntityType" >
      <attribute
        name="registryType"
        type="anyURI"
        use="required" />
      <attribute
        name="entityClass"
        type="token"
        use="required" />
      <attribute
        name="entityName"
        type="token"
        use="required" />
    </complexType>

    <!-- ======================================== -->
    <!--                                          -->
    <!-- Results                                  -->
    <!--                                          -->
    <!-- ======================================== -->

    <complexType
      name="resultType">
      <attribute
        name="authority"
        use="required"
        type="token" />
      <attribute
        name="resolution"
        type="token" />
      <attribute
        name="registryType"
        use="required"
```

```
        type="anyURI" />
      <attribute
        name="entityClass"
        use="required"
        type="token" />
      <attribute
        name="entityName"
        use="required"
        type="token" />
      <attribute
        name="temporaryReference"
        default="false"
        type="boolean" />
    </complexType>

    <element
      name="result"
      type="iris:resultType"
      abstract="true" />

    <!-- ======================================== -->
    <!--                                          -->
    <!-- Errors                                   -->
    <!--                                          -->
    <!-- ======================================== -->

    <complexType
      name="codeType">
      <sequence
        minOccurs="0"
        maxOccurs="unbounded">
        <element
          name="explanation">
          <complexType>
            <simpleContent>
              <extension
                base="string">
                <attribute
                  use="required"
                  name="language"
                  type="language" />
              </extension>
            </simpleContent>
          </complexType>
        </element>
      </sequence>
    </complexType>
```

```
    <element
      name="genericCode"
      type="iris:codeType"
      abstract="true" />

    <!-- ======================================== -->
    <!--                                          -->
    <!-- Entity References and                    -->
    <!-- Search Continuations                     -->
    <!--                                          -->
    <!-- ======================================== -->

    <complexType
      name="entityType">
      <sequence>
        <element
          name="displayName"
          minOccurs="0"
          maxOccurs="unbounded">
          <complexType>
            <simpleContent>
              <extension
                base="string">
                <attribute
                  name="language"
                  use="required"
                  type="language" />
              </extension>
            </simpleContent>
          </complexType>
        </element>
      </sequence>
      <attribute
        name="authority"
        use="required"
        type="token" />
      <attribute
        name="resolution"
        type="token" />
      <attribute
        name="registryType"
        use="required"
        type="anyURI" />
      <attribute
        name="entityClass"
        use="required"
        type="token" />
      <attribute
```

```
        name="entityName"
        use="required"
        type="token" />
      <attribute
        name="referentType"
        use="required"
        form="qualified"
        type="iris:referentTypeType" />
      <attribute
        name="temporaryReference"
        default="false"
        type="boolean" />
      <attribute
        name="bagRef"
        type="IDREF" />
    </complexType>

    <element
      name="entity"
      type="iris:entityType" />

    <simpleType
      name="referentTypeType">
      <union
        memberTypes="QName iris:anyLiteralType" />
    </simpleType>

    <simpleType
      name="anyLiteralType">
      <restriction
        base="string">
        <enumeration
          value="ANY" />
      </restriction>
    </simpleType>

    <complexType
      name="searchContinuationType">
      <sequence>
        <element ref="iris:query" />
      </sequence>
      <attribute
        name="bagRef"
        type="IDREF" />
      <attribute
        name="authority"
        type="token"
        use="required" />
```

```
      <attribute
        name="resolution"
        type="token" />
    </complexType>

    <element
      name="searchContinuation"
      type="iris:searchContinuationType" />

    <!-- ======================================== -->
    <!--                                          -->
    <!-- Bags                                     -->
    <!--                                          -->
    <!-- ======================================== -->

    <complexType
      name="bagsType">
      <sequence>
        <element
          name="bag"
          minOccurs="1"
          maxOccurs="unbounded">
          <complexType>
            <complexContent>
              <extension
                base="iris:bagType">
                <attribute
                  use="required"
                  name="id"
                  type="ID" />
              </extension>
            </complexContent>
          </complexType>
        </element>
      </sequence>
    </complexType>

    <complexType
      name="bagType">
      <sequence>
        <any
          namespace="##any"
          processContents="skip"
          minOccurs="1"
          maxOccurs="1" />
      </sequence>
    </complexType>
```

```
    <!-- ======================================== -->
    <!--                                          -->
    <!-- Derived Results for use with all         -->
    <!-- registry types.                          -->
    <!--                                          -->
    <!-- ======================================== -->

    <!--                                          -->
    <!-- See Also                                 -->
    <!--                                          -->

    <element
      name="seeAlso"
      type="iris:entityType" />

    <!--                                          -->
    <!-- Service Identification                   -->
    <!--                                          -->

    <complexType
      name="serviceIdentificationType">
      <complexContent>
        <extension
          base="iris:resultType">
          <sequence>
            <element
              name="authorities"
              minOccurs="1"
              maxOccurs="1">
              <complexType>
                <sequence>
                  <element
                    name="authority"
                    type="token"
                    minOccurs="1"
                    maxOccurs="unbounded" />
                </sequence>
              </complexType>
            </element>
            <element
              name="operatorName"
              type="string"
              minOccurs="0"
              maxOccurs="1" />
            <element
              name="eMail"
              type="string"
              minOccurs="0"
```

```
              maxOccurs="unbounded" />
            <element
              name="phone"
              type="string"
              minOccurs="0"
              maxOccurs="unbounded" />
            <element
              ref="iris:seeAlso"
              minOccurs="0"
              maxOccurs="unbounded" />
          </sequence>
        </extension>
      </complexContent>
    </complexType>

    <element
      name="serviceIdentification"
      type="iris:serviceIdentificationType"
      substitutionGroup="iris:result" />

    <!--                                          -->
    <!-- Limits                                   -->
    <!--                                          -->

    <complexType
      name="limitsType">
      <complexContent>
        <extension
          base="iris:resultType">
          <sequence>
            <element
              name="totalQueries"
              minOccurs="0"
              maxOccurs="1" >
              <complexType>
                <group
                  ref="iris:timeLimitsGroup"
                  minOccurs="1"
                  maxOccurs="4" />
              </complexType>
            </element>
            <element
              name="totalResults"
              minOccurs="0"
              maxOccurs="1" >
              <complexType>
                <group
                  ref="iris:timeLimitsGroup"
```

```
                minOccurs="1"
                maxOccurs="4" />
            </complexType>
          </element>
          <element
            name="totalSessions"
            minOccurs="0"
            maxOccurs="1" >
            <complexType>
              <group
                ref="iris:timeLimitsGroup"
                minOccurs="1"
                maxOccurs="4" />
            </complexType>
          </element>
          <element
            name="otherRestrictions"
            minOccurs="0"
            maxOccurs="1">
            <complexType>
              <sequence>
                <element
                  name="description"
                  minOccurs="0"
                  maxOccurs="unbounded">
                  <complexType>
                    <simpleContent>
                      <extension
                        base="string">
                        <attribute
                          name="language"
                          type="language"
                          use="required" />
                      </extension>
                    </simpleContent>
                  </complexType>
                </element>
              </sequence>
            </complexType>
          </element>
          <element
            ref="iris:seeAlso"
            minOccurs="0"
            maxOccurs="unbounded" />
        </sequence>
      </extension>
    </complexContent>
  </complexType>
```

```
    <element
      name="limits"
      type="iris:limitsType"
      substitutionGroup="iris:result" />

    <group
      name="timeLimitsGroup">
      <choice>
        <element
          name="perSecond"
          type="nonNegativeInteger" />
        <element
          name="perMinute"
          type="nonNegativeInteger" />
        <element
          name="perHour"
          type="nonNegativeInteger" />
        <element
          name="perDay"
          type="nonNegativeInteger" />
      </choice>
    </group>

    <!--                                          -->
    <!-- Simple Entity                            -->
    <!--                                          -->

    <complexType
      name="simpleEntityType">
      <complexContent>
        <extension
          base="iris:resultType">
          <sequence>
            <element
              name="property"
              minOccurs="1"
              maxOccurs="unbounded">
              <complexType>
                <simpleContent>
                  <extension
                    base="string">
                    <attribute
                      name="name"
                      type="string"
                      use="required" />
                    <attribute
                      name="language"
                      type="language"
```

```
                    use="required" />
                  <attribute
                    name="uri"
                    type="anyURI" />
                </extension>
              </simpleContent>
            </complexType>
          </element>
        </sequence>
      </extension>
    </complexContent>
  </complexType>

  <element
    name="simpleEntity"
    type="iris:simpleEntityType"
    substitutionGroup="iris:result" />

  <!-- ======================================== -->
  <!--                                          -->
  <!-- Derived Controls and Reactions           -->
  <!--                                          -->
  <!-- ======================================== -->

  <!--                                          -->
  <!-- Only Check Permissions                   -->
  <!--                                          -->

  <element
    name="onlyCheckPermissions" >
    <complexType />
  </element>

  <!--                                          -->
  <!-- Standard Reaction                        -->
  <!--                                          -->

  <element
    name="standardReaction" >
    <complexType>
      <choice>
        <element
          name="controlAccepted">
          <complexType/>
        </element>
        <element
          name="controlDenied">
          <complexType/>
```

```
          </element>
          <element
            name="controlDisabled">
            <complexType/>
          </element>
          <element
            name="controlUnrecognized">
            <complexType/>
          </element>
        </choice>
      </complexType>
    </element>

    <!-- ======================================== -->
    <!--                                          -->
    <!-- Serialization                            -->
    <!--                                          -->
    <!-- ======================================== -->

    <complexType
      name="serializedReferralType">
      <sequence>
        <element name="source">
          <complexType>
            <attribute
              name="authority"
              use="required"
              type="token" />
            <attribute
              name="resolution"
              type="token" />
            <attribute
              name="registryType"
              type="anyURI"
              use="required" />
            <attribute
              name="entityClass"
              type="token"
              use="required" />
            <attribute
              name="entityName"
              type="token"
              use="required" />
          </complexType>
        </element>
        <choice>
          <element
            ref="iris:searchContinuation" />
```

```
          <element
            ref="iris:entity" />
        </choice>
      </sequence>
    </complexType>

    <element
      name="serialization">
      <complexType>
        <choice
          minOccurs="1"
          maxOccurs="unbounded">
          <element
            ref="iris:result" />
          <element
            name="serializedReferral"
            type="iris:serializedReferralType" />
        </choice>
      </complexType>
    </element>

  </schema>
```

Figure 8

7. The IRIS URI

The IRIS URI has a very rigid structure but is flexible in how it may be used. Its structure is rigid in that all IRIS URIs have the same fields and all look similar to users.

They are flexible because they allow different methods to be employed to find servers and they allow the use of multiple transports (with BEEP being the default).

7.1 URI Definition

An IRIS URI [6] has the following general syntax.

iris:<registry>/<resolution>/<authority>/<class>/<name>

The full ABNF [11] with certain values included from RFC 2396 [6] and RFC 2732 [15] follows.

```
  iris-uri           = scheme ":" registry-urn "/"
                       [ resolution-method ] "/" authority
                       [ "/" entity-class "/" entity-name ]
  scheme             = "iris"
  authority          = // as specified by RFC2396
  registry-urn       = // as specified by IRIS
  resolution-method  = *(unreserved | escaped)
  entity-class       = *(unreserved | escaped)
  entity-name        = *(unreserved | escaped)
  unreserved         = // as specified by RFC2396
  escaped            = // as specified by RFC2396
```

An IRIS URI MUST NOT be a relative URI. The resolution method, entity class and entity name MUST be of the UTF-8 [12] character set encoded with "application/x-www-form-urlencoded" as specified by URL_ENC [14].

When the entity-class and entity-name components are not specified, the defaults "iris" and "id" MUST be implied. For example, "iris:dreg1//com" is to be interpreted "iris:dreg1//com/iris/id".

When the resolution-method is not specified, the default is the direct resolution method described in Section 7.3.2.

7.2 Transport Specific Schemes

The "iris" scheme name is not application transport specific. The URI resolution process MAY determine the application transport. An

example of such a process is the direct resolution (Section 7.3.2) process, which uses the steps outlined in Section 7.3.3 to determine the application transport.

A mapping between an application transport and IRIS MAY define a scheme name signifying its use with the semantics of the IRIS URI.

The rules for determining which application transport to use are:

- If an application transport specific scheme name is present, the application transport it signifies SHOULD be used if possible.
- If a client has a preferred transport and the resolution process allows for its use, the client MAY use that application transport.
- Otherwise, the default application transport as specified by IRIS-BEEP [1] MUST be used.

7.3 URI Resolution

7.3.1 Registry Dependent Resolution

Interpretation and resolution of the authority component of an IRIS URI may be altered with the specification of a resolution-method in the URI. If no resolution-method component is specified in the URI, the default is the direct resolution method (see Section 7.3.2).

Alternate resolution methods MAY be specified by registry types. The identifiers for these methods MUST conform to the ABNF in Section 7.1.

7.3.2 Direct Resolution

In the direct resolution process, the authority component of an IRIS URI may only contain a domain name, a domain name accompanied by a port number, an IP address, or an IP address accompanied by a port number. The authority component of the scheme indicates the server or set of servers authoritatively responsible for a domain according to records in DNS (Section 7.3.3) if a domain is specified or indicates the specific server to be queried if an IP address is specified.

The rules for resolution are:

- If the authority component is a domain name accompanied by a port number as specified by RFC 2396, the domain name is converted to an IP address via an A or AAAA record to the DNS.
- If the authority component is a domain name by itself, the service/transport location (Section 7.3.3) process is used. If this process produces no results, then the DNS is queried for the

A or AAAA RRs corresponding to the domain name and the port number used is the well-known port of the transport used according to Section 7.2.

- If the authority component is an IP address, then the DNS is not queried, and the IP address is used directly. If the port number is present, it is used directly; otherwise, the port number used is the well-known port of the transport used according to Section 7.2.

The use of an IPv6 address in the authority component MUST conform to RFC 2732 [15].

7.3.3 Transport and Service Location

The direct resolution method (Section 7.3.2) uses the profiled use of the NAPTR and SRV resource records as defined in S-NAPTR [10] to determine both the location of a set of servers for a given service and the set of possible transports that may be used. It is RECOMMENDED that any resolution method not making explicit use of the direct resolution process should use S-NAPTR [10] in whatever process it does define.

S-NAPTR [10] requires an application service label. The direct resolution method (Section 7.3.2) uses the abbreviated form the registry URN as the application service label. Other resolution methods MAY specify other application service labels.

See Appendix A for example uses of S-NAPTR.

7.4 IRIS URI Examples

Here are some examples of IRIS URIs and their meaning:

- iris:dreg1//example.com/domain/example.com
  - Finds a server authoritative for "example.com" according to the rules of direct resolution (Section 7.3.2).
  - The server is asked for "example.com" in the "domain" index, or entity class, of the "dreg1" registry.
- iris:dreg1//example.com
  - Finds a server authoritative for "example.com" according to the rules of direct resolution (Section 7.3.2).
  - The server is asked for "id" in the "iris" index, or entity class, of the "dreg1" registry.
- iris:dreg1//com/domain/example.com
  - Finds a server authoritative for "com" according to the rules of direct-resolution (Section 7.3.2).
  - The server is asked for "example.com" in the "domain" index, or entity class, of the "dreg1" registry.

- iris:dreg1//192.0.2.1:44/domain/example.com
  - Following the rules of direct-resolution (Section 7.3.2), the server at IP address 192.0.2.1 on port 44 is queried using BEEP.
  - The server is asked for "example.com" in the "domain" index, or entity class, of the "dreg1" registry.
- iris.lwz:dreg1//192.0.2.1:44/domain/example.com
  - Following the rules of direct-resolution (Section 7.3.2), the server at IP address 192.0.2.1 on port 44 is queried using a lightweight application transport.
  - The server is asked for "example.com" in the "domain" index, or entity class, of the "dreg1" registry.
- iris.beep:dreg1//com/domain/example.com
  - Finds a server authoritative for "com" according to the rules of direct-resolution (Section 7.3.2).
  - Uses the BEEP application transport.
  - The server is asked for "example.com" in the "domain" index, or entity class, of the "dreg1" registry.
- iris:dreg1/bottom/example.com/domain/example.com
  - Finds a server authoritative for "example.com" according to the rules of the resolution method 'bottom' defined by the registry type urn:ietf:params:xml:ns:dreg1.
  - The application transport used is determined by the 'bottom' resolution method.
  - The server is asked for "example.com" in the "domain" index, or entity class, of the "dreg1" registry.
- iris.beep:dreg1/bottom/example.com/domain/example.com
  - Finds a server authoritative for "example.com" according to the rules of the resolution method 'bottom' defined by the registry type urn:ietf:params:xml:ns:dreg1.
  - Uses the BEEP application transport.
  - The server is asked for "example.com" in the "domain" index, or entity class, of the "dreg1" registry.

8. Checklists

8.1 Registry Definition Checklist

Specifications of registry types MUST include the following explicit definitions:

- Formal XML syntax deriving from the IRIS XML.
- An identifying registry URN.
- Any registry specific resolution methods.
- A registration of the abbreviated registry URN as an application service label for compliance with S-NAPTR [10]. Note, this is a different IANA registry than the registry type URN IANA registry.
- A list of well-known entity classes.
- A statement regarding the case sensitivity of the names in each entity class.

8.2 Transport Mapping Checklist

Specifications of transport mappings MUST include the following explicit definitions:

- A URI scheme name specific to the transport.
- An application protocol label for compliance with S-NAPTR [10]. See Section 7.3.3. Note, this is a different IANA registry than the URI scheme name IANA registry, however, it is RECOMMENDED that they be the same string of characters.
- The set of allowable character set encodings for the exchange of XML (see Section 9).
- The set of security mechanisms.

9. Internationalization Considerations

IRIS is represented in XML. XML processors are obliged to recognize both UTF-8 and UTF-16 [12] encodings. XML provides for mechanisms to identify and use other character encodings by means of the "encoding" attribute in the <xml> declaration. Absence of this attribute or a byte order mark (BOM) means a default of UTF-8 [13] encoding. Thus, for compatibility reasons, and per RFC 2277 [16], use of UTF-8 [13] is RECOMMENDED with IRIS.

The complete list of character set encoding identifiers is maintained by IANA at [21].

The application-transport layer MUST define a common set of character set encodings to be understood by both client and server.

Localization of internationalized strings may require additional information by the client. Entity definitions SHOULD use the "language" type defined by XML_SD [4] to aid clients in the localization process. See Section 4.3.7.3 as an example.

10. IANA Considerations

This document makes use of a proposed XML namespace and schema registry specified in XML_URN [9]. Accordingly, the following registration information is provided for the IANA:

- URN/URI:
  - urn:ietf:params:xml:ns:iris1
- Contact:
  - Andrew Newton <andy@hxr.us>
  - Marcos Sanz <sanz@denic.de>
- XML:
  - The XML Schema specified in Section 6

11. Security Considerations

The IRIS XML layer provides no authentication or privacy facilities of its own. It relies on the application-transport layer for all of these abilities. Application-transports should explicitly define their security mechanisms (see Section 8.2).

Referral IRIS registry results may contain entity lookups and search continuations which result in a client query operation against another registry service. Clients SHOULD NOT use authentication credentials and mechanisms subject to replay attacks for the purpose of conducting subsequent entity lookups and search continuations.

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URIs

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Appendix A. S-NAPTR and IRIS Uses

A.1 An Examples of S-NAPTR with IRIS

This section shows an example use of S-NAPTR [10] by IRIS. In this example, there are two registry types: REGA and REGB. There are also two IRIS application transports: iris-a and iris-b. Given this, the use of S-NAPTR offers the following:

1. A means to allow an operator to split out the set of servers running REGA from the set of servers running REGB. This is to say, the operator is able to split out the set of servers serving up data for REGA from the set of servers serving up data for REGB.
2. A means to allow an operator to specify which set of servers are running iris-a from the set of servers running iris-b. This is to say, the operator is able to split out the set of servers running protocol iris-a serving REGA and REGB data from the set of servers running protocol iris-b serving REGA and REGB data.
3. A means to allow an operator to specify which set of the servers to operate and which set of the above servers to delegate to another operator.

To implement the first feature, the operator deploys the following in their DNS zone:

```
example.com.
;;        order  pref  flags service                re re replacement
IN NAPTR  100    10    ""    "REGA:iris-a:iris-b"    "" rega.example.com
IN NAPTR  100    10    ""    "REGB:iris-a:iris-b"    "" regb.example.com
```

To implement the second feature, the operator then adds the following in their DNS zone:

```
rega.example.com.
;;        order  pref  flags  service        re  replacement
IN NAPTR  100    10    "s"    "REGA:iris-a"  ""  _iris-a._udp.example.com
regb.example.com.
IN NAPTR  100    10    "s"    "REGA:iris-b"  ""  _iris-b._tcp.example.com

_iris-a._udp.example.com.
;;        pref  weight port  target
IN SRV    10    0      34    big-a.example.com.
IN SRV    20    0      34    small-a.example.com.

_iris-b._tcp.example.com.
;;        pref  weight port  target
IN SRV    10    0      34    big-b.example.com.
IN SRV    20    0      34    small-b.example.com.
```

Finally, an operator may decide to operate the REGA services while delegating the REGB services to somebody else. Here is how that is done:

```
example.com.
;;       order pref flags service              re replacement
IN NAPTR 100   10   ""    "REGA:iris-a:iris-b" "" rega.example.com
IN NAPTR 100   10   ""    "REGB:iris-a:iris-b" "" somebodyelse.com
```

Or the operator may decide to operate REGB services under the iris-a protocol/transport while delegating the REGB services under the iris-b protocol/transport to somebody else.

```
example.com.
;;       order pref flags service       re replacement
IN NAPTR 100   10   ""    "REGB:iris-a:iris-b" "" regb.example.com
IN NAPTR 100   10   "s"   "REGB:iris-a" "" _iris-a._udp.example.com
IN NAPTR 100   10   "s"   "REGB:iris-b" "" _iris-b._tcp.somebodyelse.com

_iris-a._udp.example.com.
;;        pref  weight port  target
IN SRV    10    0      34    big-a.example.com.
IN SRV    20    0      34    small-a.example.com.
```

Note that while this last example is possible, it is probably not advisable because of the operational issues involved in synchronizing the data between example.com and somebodyelse.com. It is provided here as an example of what is possible.

A.2 Using S-NAPTR for Cohabitation

Given the examples in Appendix A.1, the use of S-NAPTR could be part

of a transition strategy for cohabitation of protocols solving the problems of CRISP [17].

For example, the type of data for domain information could be given the application service label of "DREG1". Given this, the service field of an S-NAPTR compliant NAPTR record could read:

"DREG1:whois:iris-beep"

This service field conveys that domain data, as defined by CRISP, is available both via the iris-beep protocol and the whois protocol. The whois application protocol label refers to RFC 954 [19].

Appendix B. IRIS Design Philosophy

Beyond the concrete arguments that could be placed behind a thoughtful analysis of the bits flying across the ether, there are other abstract reasons for the development of IRIS. This section attempts an explanation.

B.1 The Basic Premise

IRIS has been designed as a directory service for public-facing registries of Internet resources. The basic premise is this:

- A client should be able to look up any single piece of data from any type of registry. This look up should involve a straight-forward and consistent definition for finding the registry and entail a hit to a single data index in the registry.
- Anything more, such as searches up and down the DNS tree to find the registry, searches across multiple indexes in a registry, etc..., requires a client with special knowledge of the data relationships contained within a registry.

Therefore IRIS does the following:

- It does specify the basic schema language used by all registries to specify their schemas.
- It does provide the basic framework for a registry to make a reference to an entity in another type of registry.

And, therefore, IRIS does not do the following:

- It does not specify a common query language across all types of registries. A common query language imposed across multiple types of registries usually results in the disabling of certain functions by a server operator in order to meet acceptable levels of performance. What this leaves is a common query language that does not commonly work.
- It does not impose any relationship between sets of data in any type of registry, such as specifying a tree. There are many types of Internet resources, and they do not all share the same style of relationship with their contained sets of data. An imposition of a common relationship when it is not a natural fit is often a concern and not a benefit.

B.2 The Lure of a Universal Client

The design premise of IRIS signifies that for directory services there is no such thing as a universal client (or that if there is one, it is commonly called the "web browser").

For IRIS, the closest thing to a universal client is one that may "look up" data and may be able to display the data in a rudimentary

fashion. For a client to be able to "search" data or display it in a truly user-friendly manner, it must have specific knowledge about the type of data it is retrieving.

Attempts to outfit a universal client with a common query language are also not very useful. A common query language may be applied to a specific problem domain, requiring a user to have expertise in both the common query language and the problem domain. In the end, the outcome is usually the development of a client specific to the problem domain but saddled with translation of the user's desires and the lowest common denominator aspect of the query language.

B.3 Server Considerations

As mentioned above, IRIS was designed for the directory service needs of public-facing registries. In this light, there are certain aspects of more generalized directory services that are a hindrance in an environment that does not have the same control and safety considerations of a managed network.

For instance, a common query language can provide great flexibility to both the power user and the abusive user. An abusive user could easily submit a query across multiple indexes with partial values. Such a query would have no other utility than to cause denial of service to other users. To combat this, a service operator must restrict the types of queries that cause harm to overall performance, and this act obsoletes the benefit of a common query language.

Another consideration for server performance is the lack of a required data relationship. Because sets of data often have differing relationships, a one-size-fits-all approach does not fit well with all types of registries. In addition, public-facing services tend to have service level requirements that cannot reasonably be met by transforming complete data stores from a native format to that of a format enforcing an artificial set of relationships.

To combat these issues, operators of public-facing services tend to create their own custom query parsers and back-end data stores. But doing so brings into question the use of a generalized directory service.

Finally, IRIS is built upon a set of standard technological layers. This allows service operators the ability to switch in and out components to meet the needs of their particular environment.

B.4 Lookups, Searches, and Entity Classes

IRIS supports both look ups and searches. Conceptually, the difference between the two is as follows:

A "look up" is a single query with a discrete value on a single index.

Anything more, such as a partial value queries, queries across multiple indexes, or multiple queries to a single index, is a "search".

Lookups are accomplished through the use of the defined query <lookupEntity>. This query specifies a discrete name, called the entity name, to be queried in a single index, called the entity class. Therefore, implementations may consider a type of registry to be composed of multiple indexes, one for each defined entity class.

There are no standard searches in IRIS. Each type of registry defines its own set of searches.

B.5 Entities References, Search Continuations, and Scope

Due to its importance in client behavior and the side effects such behavior may have on servers, IRIS makes a clear distinction between entity references (<entity>) and search continuations (<searchContinuation>). It is not an add-on, but a fundamental core of the protocol.

The distinction is very important to a client:

"Go look over there and you will find what you seek."

"Go look over there and you may find what you seek, or you may find some other stuff, or you may find nothing."

Finally, because IRIS makes no assumptions and places no requirements on the relationship of data in a registry, this also extends to data of the same registry type spread across multiple authority areas. This means that IRIS makes no requirements with regard to scope of entity references or search continuations. The definition of scope is strictly a function of need by the type of registry and the allowances given a service operator by that type of registry.

Appendix C. Acknowledgments

The terminology used in this document to describe namespaces and namespaces of namespaces is now much clearer thanks to the skillful debating tactics of Leslie Daigle. Previously, it was much more confusing. In addition, Leslie has provided great insight into the details of URIs, URNs, and NAPTR/SRV resource records.

Many other technical complexities were proved to be unnecessary by David Blacka and have been removed. And his IRIS implementation has helped smooth out the rougher edges.

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Acknowledgment

Funding for the RFC Editor function is currently provided by the Internet Society.