Describing Simple Data Access Services

Version 1.1

IVOA Recommendation 2017-05-30

Working group
Registry

This version
http://www.ivoa.net/documents/SimpleDALRegExt/20170530

Latest version
http://www.ivoa.net/documents/SimpleDALRegExt

Previous versions
WD-20160525
REC-1.0
PR-20130911
PR-20121116
PR-20120517
WD-20110921

Author(s)
Raymond Plante, Markus Demleitner, Jesus Delago, Paul Harrison, Doug Tody

Editor(s)
Ray Plante, Markus Demleitner

Version Control
Revision 4109, 2017-05-30 16:58:46 +0200 (Tue, 30 May 2017)
https://volute.g-vo.org/svn/trunk/projects/registry/SimpleDALRegExt/SimpleDALRegExt.tex
Abstract

An application that queries or consumes descriptions of VO resources must be able to recognize a resource’s support for standard IVOA protocols. This specification describes how to describe a service that supports any of the four typed data access protocols – Simple Cone Search (SCS), Simple Image Access (SIA), Simple Spectral Access (SSA), Simple Line Access (SLA) – using the VOResource XML encoding standard. A key part of this specification is the set of VOResource XML extension schemas that define new metadata that are specific to those protocols. This document describes rules for describing such services within the context of IVOA Registries and data discovery as well as the VO Support Interfaces (VOSI) and service self-description. In particular, this document spells out the essential mark-up needed to identify support for a standard protocol and the base URL required to access the interface that supports that protocol.

Status of This Document

This document has been reviewed by IVOA Members and other interested parties, and has been endorsed by the IVOA Executive Committee as an IVOA Recommendation. It is a stable document and may be used as reference material or cited as a normative reference from another document. IVOA’s role in making the Recommendation is to draw attention to the specification and to promote its widespread deployment. This enhances the functionality and interoperability inside the Astronomical Community.

A list of current IVOA Recommendations and other technical documents can be found at http://www.ivoa.net/documents/.

Contents

1 Introduction 4
  1.1 The Role in IVOA Architecture 6
  1.2 Dependencies on Other Standards 7

2 The Common Data Model for Simple DAL Services 8

3 Describing Standard Capabilities 10
  3.1 Simple Cone Search 11
    3.1.1 The Standard Identifier 11
    3.1.2 The Schema Namespace 11
    3.1.3 ConeSearch 11
    3.1.4 testQuery and the Query Type 13
  3.2 Simple Image Access 14
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2.1</td>
<td>The Standard Identifier</td>
<td>14</td>
</tr>
<tr>
<td>3.2.2</td>
<td>The Schema Namespace</td>
<td>14</td>
</tr>
<tr>
<td>3.2.3</td>
<td>SimpleImageAccess</td>
<td>15</td>
</tr>
<tr>
<td>3.2.4</td>
<td>SkySize</td>
<td>18</td>
</tr>
<tr>
<td>3.2.5</td>
<td>testQuery and the Query Type</td>
<td>19</td>
</tr>
<tr>
<td>3.2.6</td>
<td>SkyPos</td>
<td>20</td>
</tr>
<tr>
<td>3.3</td>
<td>Simple Spectral Access</td>
<td>20</td>
</tr>
<tr>
<td>3.3.1</td>
<td>The Standard Identifier</td>
<td>20</td>
</tr>
<tr>
<td>3.3.2</td>
<td>The Schema Namespace</td>
<td>21</td>
</tr>
<tr>
<td>3.3.3</td>
<td>SimpleSpectralAccess</td>
<td>21</td>
</tr>
<tr>
<td>3.3.4</td>
<td>testQuery and the Query Type</td>
<td>27</td>
</tr>
<tr>
<td>3.3.5</td>
<td>PosParam</td>
<td>28</td>
</tr>
<tr>
<td>3.3.6</td>
<td>ProtoSpectralAccess</td>
<td>29</td>
</tr>
<tr>
<td>3.4</td>
<td>Simple Line Access</td>
<td>29</td>
</tr>
<tr>
<td>3.4.1</td>
<td>The Standard Identifier</td>
<td>29</td>
</tr>
<tr>
<td>3.4.2</td>
<td>The Schema Namespace</td>
<td>29</td>
</tr>
<tr>
<td>3.4.3</td>
<td>SimpleLineAccess</td>
<td>29</td>
</tr>
<tr>
<td>3.4.4</td>
<td>testQuery and the Query Type</td>
<td>31</td>
</tr>
<tr>
<td>3.4.5</td>
<td>WavelengthRange</td>
<td>32</td>
</tr>
</tbody>
</table>

A Supporting Multiple Versions of DAL Protocols 33

B Change History 34

B.1 Changes from PR-2016-07-06 34
B.2 Changes from REC-1.0 35
B.3 Changes since PR-v1.0 20130911 35
B.4 Changes from PR-v1.0 20121116 35
B.5 Changes from PR-v1.0 20120517 36
B.6 Changes from WD-v1.0 20110921 36

Acknowledgements

This document has been developed with support from the National Science Foundation’s Information Technology Research Program under Cooperative Agreement AST0122449 with The Johns Hopkins University, from the UK Particle Physics and Astronomy Research Council (PPARC), from the European Commission’s Sixth Framework Program via the Optical Infrared Coordination Network (OPTICON), and from BMBF grant 05A14VHA (GAVO).
Syntax Notation Using XML Schema

The Extensible Markup Language, or XML, is document syntax for marking textual information with named tags and is defined by the World Wide Web Consortium (W3C) Recommendation, XML 1.0 (Bray and Paoli et al., 2008). The set of XML tag names and the syntax rules for their use is referred to as the document schema. One way to formally define a schema for XML documents is using the W3C standard known as XML Schema (Thompson and Beech et al., 2004).

This document defines the VOResource schema using XML Schema. The full Schema documents are kept on the IVOA schema repository\(^1\). The files given there are authoritative and override XML schema fragments contained in specification in case of conflicts. Note that the schema files in the IVOA repository can change over time according to the rules laid down in Harrison and Demleitner et al. (2016).

Reference to specific elements and types defined in the VOResource schema include the namespces prefix, \texttt{vr:}, as in \texttt{vr:Resource}. Reference to specific elements and types defined in the VODataService extension schema include the namespaces prefix, \texttt{vs:}, as in \texttt{vs:ParamHTTP}. Use of the \texttt{vs:} prefix in compliant instance documents is strongly recommended, particularly in the applications that involve IVOA Registries (Benson and Plante et al., 2009).

1 Introduction

Four data access service protocols play a key role in discovering data in the VO:

- Simple Cone Search (Plante and Williams et al., 2008) – searches a catalog for sources or observations that are within a given distance of a sky position.
- Simple Image Access (Dowler and Bonnarel et al., 2015) – searches an archive for spatially resolved data (like images and cubes) that overlap a given region of sky.
- Simple Spectral Access (Tody and Dolensky et al., 2012) – searches an archive for spectra of positions within a given region of sky.
- Simple Line Access (Osuna and Salgado et al., 2010) – searches a catalog specializing in descriptions of spectral line transitions.

\(^1\text{http://ivoa.net/xml/}\)
They are called “simple” because a typical query can be formed using only a few search parameters encoded into a URL (i.e., an HTTP GET request). Their power for data discovery comes from the ability of an application to form a single query according to the rules of one of these protocols and send it to multiple services selected, say, for their relevance to a scientific topic which support that protocol. The results collected from those services, in effect then, represent all the relevant data of that type known to the VO. Thus, the key for an application wishing to do a comprehensive search of the VO is to discover all of the services that support the particular standard protocol.

Service discovery in the VO is done via a searchable registry as described by the Registry Interfaces standard (Benson and Plante et al., 2009) – i.e., a searchable repository of descriptions of resources in VO. These descriptions are comprised of common standard metadata as specified in the Resource Metadata document (Hanisch and IVOA Resource Registry Working Group et al., 2007) that capture information about what a resource contains or does and who provides it. A standard registry encodes these descriptions using the VOResource XML Schema (Plante and Benson et al., 2008). Service resources in particular include capability metadata that describe the functionality it supports along with interface metadata that describe how to access that functionality. It is within the capability metadata that it is possible to indicate support for a particular standard protocol.

Capability metadata play an important role beyond just identifying support for a standard interface. More generally, they describe how the service behaves, and if applications are to make use of this information in an automated way, the behavior must be described using standardized metadata. In general, the metadata necessary for describing that behavior will be specific to the particular kind of service. In the case of a standard protocol, in which it is common that some variation in behavior is allowed while still being in compliance, it can be important to an application to know how a service complies with the standard for two reasons:

1. The application may wish to search for and select services that support a particular protocol feature. For example, an application may wish to find image services that can create cut-outs on-the-fly.

2. The application may wish to plan its use of the service according its limitations, such as the maximum region of sky that can be searched in one query.

It is important to note that the relevant behavioral differences between separate services that support a common protocol—and thus the metadata used to describe those behaviors—will be specific to that protocol. That is, for example, the ability to create image cut-outs is irrelevant to the Simple Cone.
Search protocol. Consequently, it is necessary to define protocol-specific metadata to adequately describe a service’s support for that protocol. This document defines such capability metadata for SCS, SIA, SSA, and SLA.

This document describes for each of the standard data access protocols – SCS, SIA, SSA, and SLA – precisely how to describe a service that supports one of the protocols in terms of the VOResource XML encoding standard. This specification is intended to be applicable wherever VOResource records are used, but in particular, it is intended as the standard for encoding resource descriptions within an IVOA-compliant registry and for encoding capability metadata available through the VO Support Interfaces VOSI (Graham and Rixon et al., 2011).

1.1 The Role in IVOA Architecture

The IVOA Architecture (Arviset and Gaudet et al., 2010) provides a high-level view of how IVOA standards work together to connect users and applications with providers of data and services, as depicted in the diagram in Fig. 1.

In this architecture, data access protocols provide the means for users (via the User Layer) to access data from archives. Of particular importance are the standard protocols, SCS, SIA, SSA, and SLA, which allow a generic user tool to find data in any archive that supports those protocols. Registries
provide to tools in the User Layer a means to discover which archives support
the standard protocols. A registry is a repository of descriptions of resources,
such as standard services, that can be searched based on the metadata in
those descriptions.

The Registry enables applications in the User Layer to discover archives
in the Resource Layer and the services they provide for accessing data, par-
ticularly those that support the standard data access protocols like SIAP,
SCS, SSAP, and SLAP (illustrated on the right). The registry metadata
model standards (in blue text and boxes on the left) give structure to the in-
formation that enables that discovery. In particular, the SimpleDALRegExt
standard defines the metadata used to describe standard data access services
of the types listed on the right.

Resource descriptions have a well-defined structure: the core concepts are
defined in the Resource Metadata standard (Hanisch and IVOA Resource
Registry Working Group et al., 2007), and the format is defined by the
VOResource XML standard (Plante and Benson et al., 2008). Additional
metadata specialized to describe a specific kind of service are defined via
extensions to the VOResource core XML Schema. SimpleDALRegExt is one
such extension specifically for describing SCS, SIA, SSA, and SLA services
in the registry.

1.2 Dependencies on Other Standards

This specification relies directly on other IVOA standards in the following
ways:

**VOResource, v1.03 (Plante and Benson et al., 2008)**
Descriptions of services that support the standard protocols are
encoded using the VOResource XML Schema. The protocol-specific
schemas defined in this document are extensions of the VOResource
core schema.

**Typed DAL Protocols**
The standards Simple Cone Search, v1.03 (Plante and Williams
et al., 2008), Simple Image Access, v1.0 (Harrison and Tody et al.,
2009), Simple Image Access, v2.0 (Dowler and Bonnarel et al.,
2015), Simple Spectral Access, v1.04 (Tody and Dolensky et al.,
2012), and Simple Line Access, v1.0 (Osuna and Salgado et al.,
2010) describe the metadata concepts that should be included in a
description of a service that supports the specification. We expect
future versions of these standards to provide their own metadata
schemes. Unless they do, however, the relevant metadata scheme
from this document should be used.

**VODataset, v1.1 (Plante and Stébé et al., 2010)**
The interface to the standard protocol functionality is described
with a specialized Interface type, vs:ParamHTTP, which is defined in the VODataService XML Schema, an extension to VOResource. This document also recommends describing the service using VODataService resource type, vs:CatalogDataService.

This specification refers to other IVOA standards:

Registry Interfaces, v1.0 (Benson and Plante et al., 2009)
A registry that is compliant with both this specification and the Registry Interfaces standard will encode service resource descriptions according to the recommendations in this document.

VO Support Interfaces, v1.0 (Graham and Rixon et al., 2011)
A service that supports one of the target protocols as well as the capability metadata retrieval method defined by VOSI is compliant with this specification if the capability metadata are encoded according the recommendations in this document.

Unlike with the previously mentioned specifications, this specification may apply to later versions of the RI and VOSI standards.

2 The Common Data Model for Simple DAL Services

This section describes common requirements for describing the target DAL services as VOResource records.

To be recognized as a service, the DAL service resource must be described as a resource type of vr:Service (defined in the VOResource schema) or one of its legal sub-types. As specified in the VOResource specification, the resource type is set by setting the xsi:type attribute on the element representing the root of the VOResource record to the namespace-qualified resource type name.

As the DAL services respond to queries with tables of available data products, their Registry records will typically be of the resource type vs:CatalogService (defined in the VODataService extension schema). In this case, record authors are encouraged to include a full description of the columns in the table returned in query response (assuming full verbosity). The vs:CatalogService resource type also allows the record to provide sky coverage information which authors are also encouraged to provide; an exception to this would be for pure SLA services as the spectral line catalogs they serve are not strictly sky observations.

The VOResource record must include a capability element that describes the services support for the DAL protocol. The contents of the element is described in section 3. In all cases, the value of the capability
Note
In VO practice, many clients discover the standard endpoints by looking for capability elements with the standardID of the protocol they are interested in and then locating a vs:ParamHTTP-typed interface in it without regard for it being marked up with role="std". Resource record authors therefore should not include non-standard vs:ParamHTTP interfaces in capabilities with the standardIDs defined here.

The capability element describing support for the DAL protocol must include a child interface element that describes support for the required DAL interface; the xsi:type attribute on that element must be set to vs:ParamHTTP, and the role attribute must be set to "std". A accessURL element within that interface must be set to the base URL, as defined in the DAL protocol specification, that provides access to the standard DAL protocol. It is not necessary to provide the use attribute to the accessURL element (as its value can be assumed); however, when it is provided, it must be set to "base". Similarly, it is not necessary to provide the interface element with queryType or resultType elements; however, when provided, their values should be "GET" and "application/x-votable+xml", respectively. The vs:ParamHTTP allows one to describe input parameters supported by the service; description authors are encouraged to list the optional parameters and any custom parameters supported by the instance of the service.

Here is a sample interface description for a simple DAL service.

```xml
<interface xsi:type="vs:ParamHTTP" role="std">
  <accessURL use="base">
    http://adil.ncsa.uiuc.edu/cgi-bin/voimquery?survey=fk
  </accessURL>

  <!-- here is a standard, optional parameter -->
  <param use="optional" std="true">
    <name>CFRAME</name>
    <description>request to shift to a given coordinate frame.</description>
    <dataType>string</dataType>
  </param>

  <!-- here is a site-specific parameter that this service supports -->
  <param use="optional" std="false">
    <name>FREQ</name>
    <description>Frequency of observation.</description>
    <unit>Hz</unit>
    <dataType>real</dataType>
  </param>
</interface>
```
3 Describing Standard Capabilities

This section describes the specific VOResource metadata extension schemas used to describe support for the target DAL protocols. The purpose of these schemas are to provide the vr:Capability sub-type that identifies the specific protocol. These are defined employing the recommendations for vr:Capability extensions given in the VOResource standard. In particular, each extension schema has the following features:

- The namespace associated with the extension is a URI that is intended to resolve an HTTP URL to XML Schema document that defines the extension schema. This means that VOResource document authors may use this URI as the location URL within the value of xsi:schemaLocation attribute. Note that the IVOA Registry Interface standard actually requires that the VOResource records it shares with other registries provide location URLs via xsi:schemaLocation for the VOResource schema and all legal extension schemas that are used in the records. This rule would apply to the extension schemas defined in this standard.

- A particular namespace prefix is recommended for use when referring to the specialized vr:Capability sub-type defined in the schema. In general XML applications, instance documents may use any prefix; however, in a VO context, document authors are strongly advised to use the canonical prefixes given (and used) in this document to avoid confusion when raw XML is exposed to the users. This means that documents should not use two different versions of a given schema (as defined by a common canonical prefix) within the same namespace mapping; documents for which this is impossible are probably semantically invalid.

- Following VOResource practice, the schema sets elementFormDefault to "unqualified". This means that element names defined in the schema do not take a namespace prefix (as there are no global elements defined). The only place namedpaced names occur in SimpleDAL-RegExt instance elements is the Capability sub-type name given as the value of an xsi:type attribute on the capability element (see the examples in the subsections below).

- The specialized vr:Capability sub-type includes a testQuery element for encoding parameters that together can be used to test the service.
The format for encoding the individual parameters is customized for each of the four simple services covered in this specification.

### 3.1 Simple Cone Search

This section describes the ConeSearch VOResource metadata extension schema which is used to describe services that comply with the Simple Cone Search protocol (Plante and Williams et al., 2008).

#### 3.1.1 The Standard Identifier

The `standardID` value for Simple Cone Search version 1.03 (and before) is

```
ivo://ivoa.net/std/ConeSearch
```

Standard identifiers for later versions will be given in the respective standards.

#### 3.1.2 The Schema Namespace

The namespace associated with the ConeSearch extension schema is

```
http://www.ivoa.net/xml/ConeSearch/v1.0
```

the canonical prefix is `cs:`.

#### 3.1.3 ConeSearch

The `cs:ConeSearch` type is a `vr:Capability` sub-type that should be used to describe a service’s support for the Simple Cone Search protocol; it is defined as follows:

**cs:ConeSearch Type Schema Documentation**

The capabilities of a Cone Search implementation.

**cs:ConeSearch Type Schema Definition**

```xml
<xs:complexType name="ConeSearch" >
  <xs:complexContent >
    <xs:extension base="vr:Capability" >
      <xs:sequence >
        <xs:element name="maxSR" type="xs:float" minOccurs="0" maxOccurs="1" />
        <xs:element name="maxRecords" type="xs:positiveInteger" minOccurs="0" maxOccurs="1" />  
        <xs:element name="verbosity" type="xs:boolean" />
        <xs:element name="testQuery" type="cs:Query" minOccurs="0" maxOccurs="1" /> 
      </xs:sequence >
    </xs:extension >
  </xs:complexContent >
</xs:complexType >
```

cs:ConeSearch Extension Metadata Elements

Element **maxSR**
  *Type* floating-point number: *xs:float*
  *Meaning* The largest search radius, in degrees, that will be accepted by the service without returning an error condition. Not providing this element or specifying a value of 180 indicates that there is no restriction.
  *Occurrence* optional
  *Comment* Not providing a value is the prefered way to indicate that there is no restriction.

Element **maxRecords**
  *Type* *xs:positiveInteger*
  *Meaning* The largest number of records that the service will return.
  *Occurrence* optional
  *Comment* This does not refer to the total number of records in the catalog but rather maximum number of records the service is capable of returning. A limit that is greater than the number of records available in the archive is equivalent to their being no effective limit. (See RM, Hanisch 2007.)

Element **verbosity**
  *Type* boolean (true/false): *xs:boolean*
  *Meaning* True if the service supports the VERB keyword; false, otherwise.
  *Occurrence* required

Element **testQuery**
  *Type* composite: *cs:Query*
  *Meaning* A query that will result in at least on matched record that can be used to test the service.
  *Occurrence* optional

The custom metadata that the *cs:ConeSearch* type provides is given above. For the elements whose semantics map directly to service profile metadata called for in the SCS standard, section 3, there is an entry labeled “SCS Name”; this indicates the metadata name given in the SCS specification that the element in this schema corresponds to. The profile metadata listed in the SCS specification that is not covered by the elements below are covered by other metadata that are part of the core VOResource schema.
3.1.4 testQuery and the Query Type

The testQuery element is intended to help other VO components (e.g. registries, validation services, services that monitor the VO’s operational health, but typically not end users) test that the service is up and operating correctly. It provides a set of legal input parameters that should return a legal response that includes at least one matched record. Since this query is intended for testing purposes, the size of the result set should be small.

The cs:Query type captures the different components of the query into separate elements, as defined below:

cs:Query Type Schema Documentation

A query to be sent to the service

cs:Query Type Schema Definition

<xs:complexType name="Query" >
  <xs:sequence >
    <xs:element name="ra" type="xs:double" />  
    <xs:element name="dec" type="xs:double" />   
    <xs:element name="sr" type="xs:double" />  
    <xs:element name="verb" type="xs:positiveInteger" minOccurs="0" /> 
    <xs:element name="catalog" type="xs:string" minOccurs="0" /> 
    <xs:element name="extras" type="xs:string" minOccurs="0" /> 
  </xs:sequence>
</xs:complexType>

cs:Query Metadata Elements

Element ra
  Type floating-point number: xs:double
  Meaning the right ascension of the search cone’s center in decimal degrees.
  Occurrence required

Element dec
  Type floating-point number: xs:double
  Meaning the declination of the search cone’s center in decimal degrees.
  Occurrence required

Element sr
  Type floating-point number: xs:double
  Meaning the radius of the search cone in decimal degrees.
  Occurrence required

Element verb
  Type xs:positiveInteger
  Meaning the verbosity level to use where 1 means the bare minimum set of columns and 3 means the full set of available columns.
  Occurrence optional
Element catalog
Type string: xs:string
Meaning the catalog to query.
Occurrence optional
Comment When the service can access more than one catalog, this input parameter, if available, is used to indicate which service to access.

Element extras
Type string: xs:string
Meaning any extra (non-standard) parameters that must be provided (apart from what is part of base URL given by the accessURL element).
Occurrence optional
Comment this value should be in the form of name=value pairs delimited with ampersands (&).

3.2 Simple Image Access

This section describes the SIA VOResource metadata extension schema which is used to describe services that comply with versions of the Simple Image Access protocol for which the specifications do not give extensions themselves. This applies at least to versions 1.0 (Harrison and Tody et al., 2009) and 2.0 (Dowler and Bonnarel et al., 2015).

3.2.1 The Standard Identifier

The standardID value for the Simple Image Access protocol version 1.0 is

ivo://ivoa.net/std/SIA

Standard identifiers for later versions are given in the respective standards; for instance, SIA version 2.0 (Dowler and Bonnarel et al., 2015), specifies

ivo://ivoa.net/std/SIA#query-2.0

for its query capability.

3.2.2 The Schema Namespace

The namespace associated with the SIA extension schema is

http://www.ivoa.net/xml/SIA/v1.1

the canonical namespace prefix is sia:
3.2.3 SimpleImageAccess

The `sia:SimpleImageAccess` type is a `vr:Capability` sub-type that should be used to describe a service’s support for the Simple Image Access protocol; it is defined as follows:

`sia:SimpleImageAccess` Type Schema Documentation

The capabilities of an SIA implementation.

`sia:SimpleImageAccess` Type Schema Definition

```xml
<xs:complexType name="SimpleImageAccess" >
  <xs:complexContent >
    <xs:extension base="vr:Capability" >
      <xs:sequence >
        <xs:element name="imageServiceType" type="sia:ImageServiceType" />
        <xs:element name="maxQueryRegionSize" type="sia:SkySize" minOccurs="0" maxOccurs="1" />
        <xs:element name="maxImageExtent" type="sia:SkySize" minOccurs="0" maxOccurs="1" />
        <xs:element name="maxImageSize" type="xs:positiveInteger" minOccurs="0" maxOccurs="1" />
        <xs:element name="maxFileSize" type="xs:positiveInteger" minOccurs="0" maxOccurs="1" />
        <xs:element name="maxRecords" type="xs:positiveInteger" minOccurs="0" maxOccurs="1" />
        <xs:element name="testQuery" type="sia:Query" minOccurs="0" maxOccurs="1" />
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

`sia:SimpleImageAccess` Extension Metadata Elements

Element `imageServiceType`

Type: string with controlled vocabulary
Meaning: The class of image service: Cutout, Mosaic, Atlas, Pointed
Occurrence: required
Allowed Values: Cutout

This is a service which extracts or “cuts out” rectangular regions of some larger image, returning an image of the requested size to the client. Such images are usually drawn from a database or a collection of survey images that cover some large portion of the sky. To be
considered a cutout service, the returned image should closely approximate (or at least not exceed) the size of the requested region; however, a cutout service will not normally resample (rescale or reproject) the pixel data. A cutout service may mosaic image segments to cover a large region but is still considered a cutout service if it does not resample the data. Image cutout services are fast and avoid image degradation due to resampling.

Mosaic

This service is similar to the image cutout service but adds the capability to compute an image of the size, scale, and projection specified by the client. Mosaic services include services which resample and reproject existing image data, as well as services which generate pixels from some more fundamental dataset, e.g., a high energy event list or a radio astronomy measurement set. Image mosaics can be expensive to generate for large regions but they make it easier for the client to overlay image data from different sources. Image mosaicing services which resample already pixelated data will degrade the data slightly, unlike the simpler cutout service which returns the data unchanged.

Atlas

This category of service provides access to pre-computed images that make up a survey of some large portion of the sky. The service, however, is not capable of dynamically cutting out requested regions, and the size of atlas images is predetermined by the survey. Atlas images may range in size from small cutouts of extended objects to large calibrated survey data frames.

Pointed

This category of service provides access to collections of images of many small, “pointed” regions of the sky. “Pointed” images normally focus on specific sources in the sky as opposed to being part of a sky survey. This type of service usually applies to instrumental archives from observatories with guest observer programs (e.g., the HST archive) and other general purpose image archives (e.g., the ADIL). If a service provides access to both survey and pointed images, then it should be considered a Pointed Image Archive for the purposes of this specification; if a differentiation between the types of data is desired the pointed and survey data collections should be registered as separate image services.

Element maxQueryRegionSize

Type composite: sia:SkySize

Meaning The maximum image query region size, expressed in decimal degrees. Not providing this element or specifying a value of 360 degrees indicates that there is no limit and the entire data
collection (entire sky) can be queried.

Occurrence optional

Comment  Not providing a value is the preferred way to indicate that there is no limit.

Element maxImageExtent

Type  composite: sia:SkySize

Meaning  An upper bound on a region of the sky that can be covered by returned images. That is, no image returned by this service will cover more than this limit. Not providing this element or specifying a value of 360 degrees indicates that there is no fundamental limit to the region covered by a returned image.

Occurrence optional

Comment  When the imageServiceType is “Cutout” or “Mosaic”, this represents the largest area that can be requested. In this case, the “no limit” value means that all-sky images can be requested. When the type is “Atlas” or “Pointed”, it should be a region that most closely encloses largest images in the archive, and the “no limit” value means that the archive contains all-sky (or nearly so) images.

Comment  Not providing a value is the preferred way to indicate that there is no limit.

Element maxImageSize

Type  xs:positiveInteger

Meaning  A measure of the largest image the service can produce given as the maximum number of pixels along the first or second axes. Not providing a value indicates that there is no effective limit to the size of the images that can be returned.

Occurrence optional

Comment  This is primarily relevant when the imageServiceType is “Cutout” or “Mosaic”, indicating the largest image that can be created. When the imageServiceType is “Atlas” or “Pointed”, this should be specified only when there are static images in the archive that can be searched for but not returned because they are too big.

Comment  When a service is more fundamentally limited by the total number of pixels in the image, this value should be set to the square-root of that number. This number will then represent a lower limit on the maximum length of a side.

Element maxFileSize

Type  xs:positiveInteger

Meaning  The maximum image file size in bytes. Not providing a value indicates that there is no effective limit the size of files that can be returned.

Occurrence optional

Comment  This is primarily relevant when the imageServiceType is “Cutout” or “Mosaic”, indicating the largest files that can be created. When the imageServiceType is “Atlas” or “Pointed”, this should be specified only when there are static images in the archive
that can be searched for but not returned because they are too big.

**Element maxRecords**

- **Type**: `xs:positiveInteger`
- **Meaning**: The largest number of records that the Image Query web method will return. Not providing this value means that there is no effective limit.
- **Occurrence**: optional
- **Comment**: This does not refer to the total number of images in the archive but rather maximum number of records the service is capable of returning. A limit that is greater than the number of images available in the archive is equivalent to their being no effective limit. (See RM, Hanisch 2007.)

**Element testQuery**

- **Type**: composite: `sia:Query`
- **Meaning**: a set of query parameters that is expected to produce at least one matched record which can be used to test the service.
- **Occurrence**: optional

### 3.2.4 SkySize

The `sia:SkySize` type is used to capture simple rectangular extents on the sky along longitudinal and latitudinal directions. It is defined as follows:

**sia:SkySize Type Schema Definition**

```xml
<xs:complexType name="SkySize" >
  <xs:sequence >
    <xs:element name="long" type="xs:double" />
    <xs:element name="lat" type="xs:double" />
  </xs:sequence>
</xs:complexType>
```

**sia:SkySize Metadata Elements**

**Element long**

- **Type**: floating-point number: `xs:double`
- **Meaning**: The maximum size in the longitude (R.A.) direction given in degrees
- **Occurrence**: required

**Element lat**

- **Type**: floating-point number: `xs:double`
- **Meaning**: The maximum size in the latitude (Dec.) direction given in degrees
- **Occurrence**: required
3.2.5  testQuery and the Query Type

As with the other DAL `vr:capability` types, the `testQuery` element is intended to help other VO components (e.g. registries, validation services, services that monitor the VO's operational health—but typically not end users) test that the service is up and operating correctly. It provides a region of interest (plus optionally additional parameters) to be used to get a non-empty result from the service. For SIAv2, this region of interest would usually be translated into a RANGE query. Since this query is intended for testing purposes, the size of the result set should be small.

The `sia:Query` type captures the different components of the query into separate elements, as defined below:

**sia:Query Type Schema Documentation**

A query to be sent to the service

**sia:Query Type Schema Definition**

```
<xs:complexType name="Query" >
  <xs:sequence >
    <xs:element name="pos" type="sia:SkyPos" minOccurs="0" />  
    <xs:element name="size" type="sia:SkySize" minOccurs="0" />  
    <xs:element name="verb" type="xs:positiveInteger" minOccurs="0" />  
    <xs:element name="extras" type="xs:string" minOccurs="0" />  
  </xs:sequence>
</xs:complexType>
```

**sia:Query Metadata Elements**

Element `pos`

- **Type**: composite: `sia:SkyPos`
- **Meaning**: the center position of the rectangular region that should be used as part of the query to the SIA service.
- **Occurrence**: optional

Element `size`

- **Type**: composite: `sia:SkySize`
- **Meaning**: the rectangular size of the region that should be used as part of the query to the SIA service.
- **Occurrence**: optional

Element `verb`

- **Type**: `xs:positiveInteger`
- **Meaning**: the verbosity level to use where 0 means the bare minimum set of columns and 3 means the full set of available columns.
- **Occurrence**: optional

Element `extras`

- **Type**: string: `xs:string`
Meaning  any extra (particularly non-standard) parameters that must be provided (apart from what is part of base URL given by the accessURL element).

Occurrence  optional

Comment  this value should be in the form of name=value pairs delimited with ampersands (&).

3.2.6  SkyPos

The sia:SkyPos type is used to encode the testQuery’s pos element, the center position of the test region of interest.

_sia:SkyPos Type Schema Definition_

```xml
<sxs:complexType name="SkyPos">
  <sxs:sequence>
    <sxs:element name="long" type="xs:double" />
    <sxs:element name="lat" type="xs:double" />  
  </sxs:sequence>
</sxs:complexType>
```

_sia:SkyPos Metadata Elements_

Element **long**

_Type_  floating-point number: _xs:double_

_Meaning_  The sky position in the longitude (R.A.) direction

_Occurrence_  required

Element **lat**

_Type_  floating-point number: _xs:double_

_Meaning_  The sky position in the latitude (Dec.) direction

_Occurrence_  required

3.3  Simple Spectral Access

This section describes the SSA VOResource metadata extension schema which is used to describe services that comply with the Simple Spectral Access protocol, which primarily defines the ssap:SimpleSpectralAccess vr:Capability type to be used by services compliant with published SSA Recommendation (Tody and Dolensky et al., 2012).

3.3.1  The Standard Identifier

The **standardID** value for Simple Spectral access version 1.1 (and before) is

```
ivo://ivoa.net/std/SSA
```

Standard identifiers for later versions will be given in the respective standards.
Note
Though it departs a bit from convention, the ssap prefix was chosen to avoid a collision with its use in SSA for identifying UTypes from the Spectral Data Model.

3.3.2 The Schema Namespace

The namespace associated with the SSA extension schema is http://www.ivoa.net/xml/SSA/v1.1. The namespace prefix, **ssap:** should be used in applications where common use of prefixes improves interoperability (e.g. in the IVOA registries). Furthermore, we use the **ssap:** prefix in this document to refer to types defined as part of the SSA extension schema.

3.3.3 SimpleSpectralAccess

The **ssap:**SimpleSpectralAccess type is the **vr:**Capability sub-type that should be used to describe a service’s support for the Simple Spectral Access protocol; it is defined as follows:

**ssap:**SimpleSpectralAccess Type Schema Documentation

The capabilities of an SSA service implementation.

**ssap:**SimpleSpectralAccess Type Schema Definition

```xml
<x:simpleType name="SimpleSpectralAccess">
  <xs:complexContent>
    <xs:extension base="vr:Capability">
      <xs:sequence>
        <xs:element name="complianceLevel" type="ssap:ComplianceLevel" />
        <xs:element name="dataSource" type="ssap:DataSource" minOccurs="1" maxOccurs="unbounded" />
        <xs:element name="creationType" type="ssap:CreationType" minOccurs="1" maxOccurs="unbounded" />
        <xs:element name="supportedFrame" type="ssap:SupportedFrame" minOccurs="1" maxOccurs="unbounded" />
        <xs:element name="maxSearchRadius" type="xs:double" minOccurs="0" maxOccurs="1" />
        <xs:element name="maxRecords" type="xs:positiveInteger" minOccurs="0" maxOccurs="1" />
        <xs:element name="defaultMaxRecords" type="xs:positiveInteger" minOccurs="0" maxOccurs="1" />
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```
<xs:element name="maxAperture" type="xs:double" minOccurs="0" maxOccurs="1" />
<xs:element name="maxFileSize" type="xs:positiveInteger" minOccurs="0" maxOccurs="1" />
<xs:element name="testQuery" type="ssap:Query" minOccurs="0" maxOccurs="1" />
</xs:sequence>
</xs:extension>
</xs:complexType>

ssap:SimpleSpectralAccess Extension Metadata Elements

Element complianceLevel
Type string with controlled vocabulary
Meaning The category indicating the level to which this instance complies with the SSA standard.
Occurrence required
Allowed Values
query The service supports all of the capabilities and features of the SSA protocol identified as "must" in the specification, except that it does not support returning data in at least one SSA-compliant format.
minimal The service supports all of the capabilities and features of the SSA protocol identified as "must" in the specification.
full The service supports all of the capabilities and features of the SSA protocol identified as "must" or "should" in the specification.
Comment Allowed values are "query", "minimal", and "full". See definitions of allowed values for details.

Element dataSource
Type string with controlled vocabulary
Meaning The category specifying where the data originally came from.
Occurrence required; multiple occurrences allowed.
Allowed Values
survey A survey dataset, which typically covers some region of observational parameter space in a uniform fashion, with as complete as possible coverage in the region of parameter space observed.
pointed A pointed observation of a particular astronomical object or field.
custom
Data which has been custom processed, e.g., as part of a specific research project.

theory
Theory data, or any data generated from a theoretical model, for example a synthetic spectrum.

artificial
Artificial or simulated data.

**Comment**
Allowed values are "survey", "pointed", "custom", "theory", "artificial"

**Element** `creationType`

**Type** string with controlled vocabulary

**Meaning** The category that describes the process used to produce the dataset.

**Occurrence** required; multiple occurrences allowed.

**Allowed Values**

- `archival`
  The entire archival or project dataset is returned. Transformations such as metadata or data model mediation or format conversions may take place, but the content of the dataset is not substantially modified (e.g., all the data is returned and the sample values are not modified).

- `cutout`
  The dataset is subsetted in some region of parameter space to produce a subset dataset. Sample values are not modified, e.g., cutouts could be recombined to reconstitute the original dataset.

- `filtered`
  The data is filtered in some fashion to exclude portions of the dataset, e.g., passing only data in selected regions along a measurement axis, or processing the data in a way which recomputes the sample values, e.g., due to interpolation or flux transformation.

- `mosaic`
  Data from multiple non- or partially-overlapping datasets are combined to produce a new dataset.

- `projection`
  Data is geometrically warped or dimensionally reduced by projecting through a multidimensional dataset.

- `spectralExtraction`
  Extraction of a spectrum from another dataset, e.g., extraction of a spectrum from a spectral data cube through a simulated aperture.

- `catalogExtraction`
  Extraction of a catalog of some form from another dataset, e.g., extraction of a source catalog from an image, or extraction of a line list catalog from a spectrum (not valid for a SSA service).

**Comment** Typically this describes only the processing performed by
the data service, but it could describe some additional earlier pro-
cessing as well, e.g., if data is partially precomputed.

Comment
Allowed values are "archival", "cutout", "filtered", "mos-
aic", "projection", "spectralExtraction", "catalogExtraction"

Element supportedFrame
Type string with controlled vocabulary
Meaning The STC name for a world coordinate system frame sup-
ported by this service.
Occurrence required; multiple occurrences allowed.

Allowed Values

FK4
the Fundemental Katalog, system 4, frame; Besselian

FK5
the Fundemental Katalog, system 5, frame; Julien

ECLIPTIC
Ecliptic coordinates

ICRS
International Celestial Reference System

GALACTIC_I
old Galactic coordinates

GALACTIC_II
old Galactic coordinates

SUPER_GALACTIC
Super-galactic coordinates with the north pole at GALAC-
TIC_II (47.37, +6.32) and the origin at GALACTIC_II
(137.37, 0).

AZ_EL
The local azimuth and elevation frame where azimuth
increases from north through east.

BODY
A generic solar system body-centered coordinate frame

GEO_C
3D Geographic (geocentric) coordinates where the mag-
nitude is expressed as a geocentric distance

GEO_D
3D Geographic (geocentric) coordinates where the mag-
nitude is expressed as an elevation above sea-level.

MAG
Geomagnetic coordinates.

GSE
Geocentric Solar Ecliptic coordinates

GSM
Geocentric Solar Magnetic coordinates

HGC
Heliographic coordinates (Carrington)

HGS
Heliographic coordinates (Stonyhurst)
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEEQ</td>
<td>Heliographic Earth Equatorial coordinates</td>
</tr>
<tr>
<td>HRTN</td>
<td>Heliographic Radial-Tangential-Normal coordinates</td>
</tr>
<tr>
<td>HPC</td>
<td>Helioprojective Cartesian coordinates</td>
</tr>
<tr>
<td>HPR</td>
<td>Helioprojective Polar coordinates</td>
</tr>
<tr>
<td>HCC</td>
<td>Heliocentric Cartesian coordinates</td>
</tr>
<tr>
<td>HGI</td>
<td>Heliographic Inertial coordinates</td>
</tr>
<tr>
<td>MERCURY_C</td>
<td>Planteocentric coordinates on Mercury</td>
</tr>
<tr>
<td>VENUS_C</td>
<td>Planteocentric coordinates on Venus</td>
</tr>
<tr>
<td>LUNA_C</td>
<td>Selenocentric coordinates (for the Moon)</td>
</tr>
<tr>
<td>MARS_C</td>
<td>Planteocentric coordinates on Mars</td>
</tr>
<tr>
<td>JUPITER_C_III</td>
<td>Planteocentric coordinates on Jupiter, system III</td>
</tr>
<tr>
<td>SATURN_C_III</td>
<td>Planteocentric coordinates on Saturn, system III</td>
</tr>
<tr>
<td>URANUS_C_III</td>
<td>Planteocentric coordinates on Uranus, system III</td>
</tr>
<tr>
<td>NEPTUNE_C_III</td>
<td>Planteocentric coordinates on Neptune, system III</td>
</tr>
<tr>
<td>PLUTO_C</td>
<td>Planteocentric coordinates on Mercury</td>
</tr>
<tr>
<td>MERCURY_G</td>
<td>Planteographic coordinates on Mercury</td>
</tr>
<tr>
<td>VENUS_G</td>
<td>Planteographic coordinates on Venus</td>
</tr>
<tr>
<td>LUNA_G</td>
<td>Selenographic coordinates (for the Moon)</td>
</tr>
<tr>
<td>MARS_G</td>
<td>Planteographic coordinates on Mars</td>
</tr>
<tr>
<td>JUPITER_G_III</td>
<td>Planteographic coordinates on Jupiter, system III</td>
</tr>
<tr>
<td>SATURN_G_III</td>
<td>Planteographic coordinates on Saturn, system III</td>
</tr>
<tr>
<td>URANUS_G_III</td>
<td>Planteographic coordinates on Uranus, system III</td>
</tr>
<tr>
<td>NEPTUNE_G_III</td>
<td>Planteographic coordinates on Neptune, system III</td>
</tr>
<tr>
<td>PLUTO_G</td>
<td>Planteographic coordinates on Mercury</td>
</tr>
</tbody>
</table>
UNKNOWN

a frame that is either unknown or non-standard

Comment At least one recognized value must be listed. With SSA v1.1, ICRS must be supported; thus, this list must include at least this value.

Element maxSearchRadius
Type floating-point number: xs:double
Meaning The largest search radius, in degrees, that will be accepted by the service without returning an error condition. Not providing this element or specifying a value of 180 indicates that there is no restriction.
Occurrence optional
Comment Not providing a value is the preferred way to indicate that there is no restriction.

Element maxRecords
Type xs:positiveInteger
Meaning The hard limit on the largest number of records that the query operation will return in a single response. Not providing this value means that there is no effective limit.
Occurrence optional
Comment This does not refer to the total number of spectra in the archive but rather maximum number of records the service is capable of returning. A limit that is greater than the number of spectra available in the archive is equivalent to their being no effective limit. (See RM, Hanisch 2007.)

Element defaultMaxRecords
Type xs:positiveInteger
Meaning The largest number of records that the service will return when the MAXREC parameter not specified in the query input. Not providing a value means that the hard limit implied by maxRecords will be the default limit.
Occurrence optional

Element maxAperture
Type floating-point number: xs:double
Meaning The largest aperture that can be supported upon request via the APERTURE input parameter by a service that supports the spectral extraction creation method. A value of 180 or not providing a value means there is no theoretical limit.
Occurrence optional
Comment Not providing a value is the preferred way to indicate that there is no limit.

Element maxFileSize
Type xs:positiveInteger
Meaning The maximum spectrum file size in bytes that will be returned. Not providing a value indicates that there is no effective limit the size of files that can be returned.
Occurrence optional
Comment  This is primarily relevant when spectra are created on
the fly (see creationType). If the service provides access to static
spectra, this should only be specified if there are spectra in the
archive that can be searched for but not returned because they
are too big.

Element testQuery
Type composite: ssap:Query
Meaning a set of query parameters that is expected to produce at
least one matched record which can be used to test the service.
Occurrence optional

The custom metadata that the ssap:SimpleSpectralAccess type pro-
vides is given above. Note that some of these elements derive from the SSA
standard; others, from the RM standard (Hanisch and IVOA Resource Reg-
istry Working Group et al., 2007). The “Semantic Meaning” entry provides
the reference to the original definition.

3.3.4 testQuery and the Query Type

As with the other DAL ur: capability types, the testQuery element is
intended to help other VO components (e.g. registries, validation services,
services that monitor the VO’s operational health – but typically not end
users) test that the service is up and operating correctly. It provides a set of
legal input parameters that should return a legal response that includes at
least matched record. Since this query is intended for testing purposes, the
size of the result set should be small.

The ssap:Query type captures the different components of the query into
separate elements, as defined below:

ssap:Query Type Schema Documentation
A query to be sent to the service

ssap:Query Type Schema Definition
<xs:complexType name="Query" >
  <xs:sequence >
    <xs:element name="pos" type="ssap:PosParam" minOccurs="0" />
    <xs:element name="size" type="xs:double" minOccurs="0" />
    <xs:element name="queryDataCmd" type="xs:string" minOccurs="0" />
  </xs:sequence>
</xs:complexType>

ssap:Query Metadata Elements

Element pos
Type composite: ssap:PosParam
Meaning  the center position the search cone given in decimal degrees.

Occurrence  optional

Element  size
Type  floating-point number: xs:double
Meaning  the size of the search radius.
Occurrence  optional

Element  queryDataCmd
Type  string: xs:string
Meaning  Fully specified test query formatted as an URL argument list in the syntax specified by the SSA standard. The list must exclude the REQUEST argument which is assumed to be set to "queryData".
Occurrence  optional
Comment  This value must be in the form of name=value pairs delimited with ampersands (&). A query may then be formed by appending to the base URL the request argument, "REQUEST=queryData&", followed by the contents of this element.

3.3.5  PosParam

The ssap:PosParam type is used to encode the testQuery's pos element, the center position of the test region of interest; it is defined as follows:

ssap:PosParam Type Schema Documentation
a position in the sky to search.

ssap:PosParam Type Schema Definition
<x:s:complexType name="PosParam" >
<x:s:sequence >
  <x:s:element name="long" type="xs:double" />
  <x:s:element name="lat" type="xs:double" />
  <x:s:element name="refframe" type="xs:token" minOccurs="0" />
</x:s:sequence>
</x:s:complexType>

ssap:PosParam Metadata Elements

Element  long
Type  floating-point number: xs:double
Meaning  The longitude (e.g. Right Ascension) of the center of the search position in decimal degrees.
Occurrence  required

Element  lat
Type  floating-point number: xs:double
Meaning  The latitude (e.g. Declination) of the center of the search position in decimal degrees.


3.3.6 ProtoSpectralAccess

The `ssap:ProtoSpectralAccess` type still defined in the schema was intended for seamless migration of services predating the SSAP specification. It should no longer be used.

3.4 Simple Line Access

This section describes the SLA VOResource metadata extension schema which is used to describe services that comply with the Simple Line Access protocol (Osuna and Salgado et al., 2010).

3.4.1 The Standard Identifier

The `standardID` value for Simple Line Access version 1.0 is

\[ 
\text{ivo://ivoa.net/std/SLAP} 
\]

Standard identifiers for later versions will be given in the respective standards.

3.4.2 The Schema Namespace

The namespace associated with the SLA extension schema is `http://www.ivoa.net/xml/SLAP/v1.0`. The namespace prefix, `slap:`, should be used in applications where common use of prefixes improves interoperability (e.g. in the IVOA registries). Furthermore, we use the `slap:` prefix in this document to refer to types defined as part of the SLA extension schema.

3.4.3 SimpleLineAccess

The `slap:SimpleLineAccess` type is a `vr:Capability` sub-type that should be used to describe a service’s support for the Simple Line Access protocol; it is defined as follows:

\[ 
\text{slap:SimpleLineAccess Type Schema Documentation} 
\]

The capabilities of an SLAP service implementation.
slap:SimpleLineAccess Type Schema Definition

```xml
<xs:complexType name="SimpleLineAccess">
  <xs:complexContent>
    <xs:extension base="vr:Capability">
      <xs:sequence>
        <xs:element name="complianceLevel"
          type="slap:ComplianceLevel"/>
        <xs:element name="dataSource"
          type="slap:DataSource"/>
        <xs:element name="maxRecords"
          type="xs:positiveInteger"
          minOccurs="0"
          maxOccurs="1"/>
        <xs:element name="testQuery"
          type="slap:Query"
          minOccurs="0"
          maxOccurs="1"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

slap:SimpleLineAccess Extension Metadata Elements

Element **complianceLevel**

*Type*  string with controlled vocabulary

*Meaning* The category indicating the level to which this service instance complies with the SLAP standard.

*Occurrence* required

*Allowed Values*

- **minimal** The service supports all of the capabilities and features of the SLAP protocol identified as "must" in the specification.
- **full** The service supports, at a minimum, all of the capabilities and features of the SLAP protocol identified as "must" or "should" in the specification.

*Comment* Allowed values are "minimal" and "full". See definitions of allowed values for details.

Element **dataSource**

*Type*  string with controlled vocabulary

*Meaning* The category specifying where the data accessed by the service originally came from.

*Occurrence* required

*Allowed Values*

- **observational/astrophysical** Lines observed and identified in real spectra of astrophysical observations by different instrument/projects
- **observational/laboratory** Lines observed and identified in real spectra of laboratory measurements
- **theoretical** Servers containing theoretical spectral lines
Comment  Allowed values are "observational/astrophysical", "observational/laboratory", "theoretical"

Element maxRecords
Type    xs:positiveInteger
Meaning  The hard limit on the largest number of records that the query operation will return in a single response. Not providing this value means that there is no effective limit.
Occurrence  optional
Comment  This does not refer to the total number of spectra in the archive but rather maximum number of records the service is capable of returning. A limit that is greater than the number of spectra available in the archive is equivalent to their being no effective limit. (See RM, Hanisch 2007.)

Element testQuery
Type    composite: slap:Query
Meaning  A set of queryData parameters that is expected to produce at least one matched record which can be used to test the service.
Occurrence  optional
Comment  The value should include all parameters required for the test query but should exclude the baseURL and the REQUEST parameter.

3.4.4 testQuery and the Query Type

As with the other DAL ur:capability types, the testQuery element is intended to help other VO components (e.g. registries, validation services, services that monitor the VO’s operational health – but typically not end users) test that the service is up and operating correctly. It provides a set of legal input parameters that should return a legal response that includes at least matched record. Since this query is intended for testing purposes, the size of the result set should be small.

The slap:Query type captures the different components of the query into separate elements, as defined below:

slap:Query Type Schema Documentation
A query to be sent to the service, e.g., a test query.

slap:Query Type Schema Definition

```xml
<?xml version="1.0" encoding="UTF-8"?>
<xs:complexType name="Query">
  <xs:sequence>
    <xs:element name="wavelength" type="slap:WavelengthRange" minOccurs="0"/>
    <xs:element name="queryDataCmd" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
```
**slap:Query Metadata Elements**

**Element wavelength**

*Type*  composite: *slap:WavelengthRange*

*Meaning*  Spectral range in meters to be used to constrain the query of spectral lines.

*Occurrence*  optional

**Element queryDataCmd**

*Type*  string: *xs:string*

*Meaning*  Fully specified queryData test query formatted as an URL argument list in the syntax specified by the SLAP standard. The list must exclude the REQUEST argument which is assumed to be set to "queryData". VERSION may be included if the test query applies to a specific version of the service protocol.

*Occurrence*  optional

*Comment*  If queryDataCmd is used to form a query, the default value of WAVELENGTH specified above is not used; if the test query requires WAVELENGTH it should be included directly in queryDataCmd.

*Comment*  This value must be a string in the form of name=value pairs delimited with ampersands (&). A query may then be formed by appending to the baseURL the request argument, "REQUEST=queryData&", followed by the contents of this element.

### 3.4.5 WavelengthRange

The *slap:WavelengthRange* type is used to encode the *testQuery’s wavelength* element, the range of wavelengths to search.

**slap:WavelengthRange Type Schema Documentation**

Spectral range in meters to be used to constrain the query of spectral lines

**slap:WavelengthRange Type Schema Definition**

```xml
<xs:complexType name="WavelengthRange" >
  <xs:sequence >
    <xs:element name="minWavelength" type="xs:double" minOccurs="0" />  
    <xs:element name="maxWavelength" type="xs:double" minOccurs="0" /> 
  </xs:sequence>
</xs:complexType>
```

**slap:WavelengthRange Metadata Elements**

**Element minWavelength**

*Type*  floating-point number: *xs:double*

*Meaning*  Minimum wavelength in meters to be used to constrain the query of spectral lines

*Occurrence*  optional
A  Supporting Multiple Versions of DAL Protocols

This section is non-normative.

It is possible for a VOResource-encoded resource description to indicate support for multiple versions of standard service. This is described in general terms in Section 2.2.2 (“The service data model”) of the VOResource specification (Plante and Benson et al., 2008). In that section, the specification says that a capability element can contain multiple interface elements, each describing a different version.

In VO practice, in particular after the publication of StandardsRegExt (Harrison and Burke et al., 2012), it turned out that declaring support of particular versions of IVOA standards (typically) happens with different capabilities, each with a different standardID, rather than providing multiple interface elements with differing version attributes as originally envisioned.

Here is an example a service that supports both SIA versions 1.0 and 2.0, as well as a web browser interface on the 1.0 endpoint:

```xml
<vr:Resource xsi:type="vs:CatalogService">
  <title>Example Image Service</title>
  ...
  <capability standardID="ivo://ivoa.net/std/SIA">
    <!-- this describes a SIA version 1 "face" of the service -->
    <interface role="std" xsi:type="vs:ParamHTTP">
      <!-- this is the SIA version 1.0 endpoint, the one standard clients talk to-->
      <accessURL use="base">http://example.com/asvc/sia.xml?</accessURL>
      <queryType>GET</queryType>
      <resultType>application/x-votable+xml</resultType>
      <param std="true">
        <name>POS</name>
        <description>ICRS Position, RA,DEC decimal degrees</description>
        [... enumerate the parameters supported ...]
      </param>
    </interface>
  </capability>
  <capability standardID="ivo://ivoa.net/std/SIA">
    <!-- this describes a SIA version 1 "face" of the service -->
    <interface xsi:type="vr:WebBrowser">
      <!-- this a a very SIA-like interface renderable in a web browser.
         If the web interface is functionally fairly different in interaction from a SIA version 1, put this into a separate, untyped capability -->
      <accessURL use="full">http://example.com/asvc/form.html</accessURL>
    </interface>
  </capability>
</vr:Resource>
```

Element maxWavelength

<table>
<thead>
<tr>
<th>Type</th>
<th>floating-point number: xs:double</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaning</td>
<td>Maximum wavelength in meters to be used to constrain the query of spectral lines</td>
</tr>
<tr>
<td>Occurrence</td>
<td>optional</td>
</tr>
</tbody>
</table>

33
B Change History

B.1 Changes from PR-2016-11-24

Only editorial changes.

B.2 Changes from PR-2016-07-06

- References to auxiliary SIAv2 capabilities removed again.
• Clarification that future standards are expected to override these regulations.

• Clarifications in the explanation of multi-version declarations, and how to interpret TestQuery for SIAv2.

B.3 Changes from REC-1.0

• `standardID` values are no longer fixed for the various capability types.

• Now giving the `standardID` values of the existing standards in the text (since they are no longer in the schema).

• XML schemas are no longer included in the document; the files in the IVOA repository are declared authoritative.

• We now claim, essentially, to describe the S-protocol metadata schemas until the respective standards define one themselves.

• Updated example in the appendix to the style of Identifiers 2.0

• Mentioning auxiliary capabilities and giving a standard id for them.

• Removing most material on ProtoSpectralAccess.

B.4 Changes since PR-v1.0 20130911

• none other than date and status.

B.5 Changes from PR-v1.0 20121116

• for SSA’s creationType, changed specialExtraction to spectralExtraction.

• corrected Creation Type reference to section in SSA doc.

• made long and lat elements in ssap:PosParam required.

• incremented SSA schema version to 1.1 in namespace.

• refresh App. A from official schemas

• fixed typos ("IRCS" and value type for maxFileSize)

• noted that the `<long>` and `<lat>` values within the sia:SkySize type are given in degrees.

• Fixed documentation of SIA’s sia:Query type in the schema.
B.6 Changes from PR-v1.0 20120517

- The namespace URIs given in Sections 3.1.1, 3.2.1, 3.3.1, and 3.4.1 were updated to match that specified in the XSDs (i.e. to include a “v” preceding the version field).

- Several capability metadata with types xs:int and xs:float were changed to xs:positiveInteger xs:double to allow for larger/more precise numbers.

- Capability metadata that indicated maximum allowed values (e.g. <maxRecords>, <maxImageSize>, etc.) were made optional to avoid large, meaningless numbers from being provided. Now not specifying a value is the preferred way to indicate that no upper limit applies.

- Semantic definition of <sia:maxImageExtent> clarified to differentiate it from <sia:maxQueryRegionSize>

- The type for <sia:maxImageSize> was changed to xs:positiveInteger, a single number that represents the length of a side in pixels. The sia:ImageSize type (no longer needed) was dropped.

- The version field in the SIA namespace was incremented to 1.1 due to the non-backward-compatible change to <sia:maxImageSize>

- various typos and grammatical errors corrected.

B.7 Changes from WD-v1.0 20110921

- Now recommend ssap as prefix; changed all occurrences of ssa in text and schema.

- added <supportedFrame> to ssap:SimpleSpectralAccess

- removed import of VODataService schema from SIA, SSA, and Cone-search schemas.

- change base type of controlled vocab types from xs:string to xs:token for consistancy with VOResource.

References

URL: http://www.ivoa.net/documents/Notes/IVOAArchitecture
URL: http://adsabs.harvard.edu/abs/2009ivoa.spec.1104B

Bray, T., Paoli, J., Sperber-McQueen, C. M., Maler, E. and Yergeau, F. (2008), ‘Extensible markup language (XML) 1.0 (fifth edition)’, W3C Recommendation.
URL: http://www.w3.org/TR/REC-xml/

URL: http://adsabs.harvard.edu/abs/2015ivoa.spec.1223D

URL: http://adsabs.harvard.edu/abs/2011ivoa.spec.0531G

URL: http://adsabs.harvard.edu/abs/2007ivoa.spec.0302H

URL: http://adsabs.harvard.edu/abs/2012ivoa.spec.0508H

URL: http://ivoa.net/documents/Notes/XMLVers

URL: http://adsabs.harvard.edu/abs/2009ivoa.spec.1111H

URL: http://adsabs.harvard.edu/abs/2010ivoa.specQ1209O

**URL:** [http://adsabs.harvard.edu/abs/2008ivoa.spec.0222P](http://adsabs.harvard.edu/abs/2008ivoa.spec.0222P)

**URL:** [http://adsabs.harvard.edu/abs/2010ivoa.spec.1202P](http://adsabs.harvard.edu/abs/2010ivoa.spec.1202P)

**URL:** [http://adsabs.harvard.edu/abs/2008ivoa.specQ0222P](http://adsabs.harvard.edu/abs/2008ivoa.specQ0222P)

**URL:** [http://www.w3.org/TR/xmlschema-1/](http://www.w3.org/TR/xmlschema-1/)

**URL:** [http://adsabs.harvard.edu/abs/2012ivoa.spec.0210T](http://adsabs.harvard.edu/abs/2012ivoa.spec.0210T)