



TAPRegExt: a VOResource Schema Extension for Describing TAP Services

Version 1.0

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[Registry WG](#), [DAL WG](#)

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Abstract

This document describes an XML encoding standard for metadata about services implementing the table access protocol TAP [\[TAP\]](#), referred to as TAPRegExt. Instance documents are part of the service's registry record or can be obtained from the service itself. They deliver information to both humans and software on the languages, output formats, and upload methods supported by the service, as well as data models implemented by the exposed tables, optional language features, and certain limits enforced by the service.

Status of this Document

This is an IVOA Proposed Recommendation made available for public review. It is appropriate to reference this document only as a recommended standard that is under review and which may be changed before it is accepted as a full Recommendation.

A list of [current IVOA Recommendations and other technical documents](http://www.ivoa.net/Documents/) can be found at <http://www.ivoa.net/Documents/>.



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This document has borrowed extensively from StandardsRegExt [\[SRE\]](#) working drafts.

Syntax Notation Using XML Schema

This document defines the TAPRegExt schema using XML Schema [\[XSD\]](#). The full schema document is listed in [Appendix A](#). Parts of the schema appear within the main sections of this document; however, documentation nodes have been left out for the sake of brevity.

References to specific elements and types defined in the VOResource [\[VOR\]](#) schema include the namespace prefix, `vr`, as in `vr:Resource` (a type defined in the VOResource schema). References to specific elements and types defined in the TAPRegExt schema include the namespaces prefix, `tr`, as in `tr:TableAccess` (a type defined in the TAPRegExt schema). Use of the `tr` prefix in compliant instance documents is strongly recommended, particularly in applications that involve IVOA registries.

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1. Introduction

The Table Access Protocol TAP [\[TAP\]](#) allows VO clients to send queries to remote database servers and receive the results in standard formats. In addition, it defines means to discover database schemata on the remote side, to upload data from the local disk or third-party hosts, and more. TAP builds upon a variety of other standards, premier among which is the Universal Worker Service [\[UWS\]](#), which describes how client and server can negotiate the execution of a query and the retrieval of results without having to maintain a continuous connection.

To accommodate a wide variety of requirements, the TAP specification offers implementors many choices on optional features, resource limits, or locally defined functionality. One purpose of TAPRegExt is to allow the service to communicate such choices to remote clients using the mechanisms laid down in the VO Service Interfaces standard [\[VOSI\]](#).



Clients also need to discover TAP services offering certain kinds of data. Central to this is the concept of a registry in which resources can be described and consequently discovered by users and applications in the VO. Registries receive resource descriptions as defined in the IVOA standard [VOR]. In this schema, support for a standard service protocol is described as a service's capability; the associated metadata is contained within the service resource description's <capability> element.

TAPRegExt defines this capability element for TAP services. In the context of registering TAP services, an important role filled by TAPRegExt is the communication of supported data models to the registry.

1.1. TAPRegExt within the VO Architecture

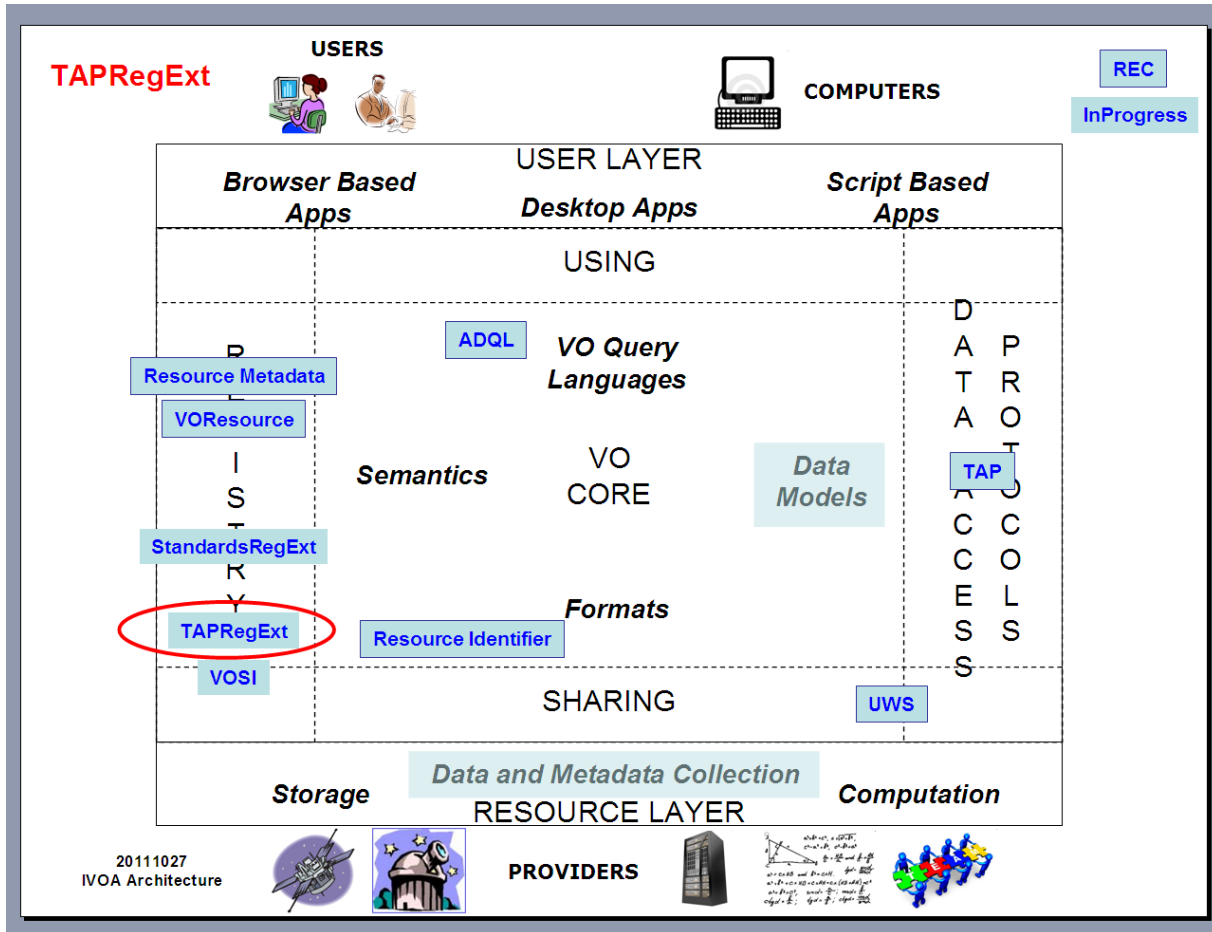


Figure 1: IVOA Architecture diagram with TAPRegExt and the related standards marked up.

This specification directly relates to other IVOA standards in the following ways:

VOResource, v1.03 [VOR]

Descriptions of services that support TAP are encoded using the VOResource XML schema. TAPRegExt is an extension of the VOResource core schema.

TAP, v1.0 [TAP]

The TAP standard describes some of the concepts, the declaration of which is the scope of TAPRegExt; the standard indirectly refers to this document in the specification of its capabilities endpoint.



UWS, v1.0 [\[UWS\]](#)

The UWS standard describes additional parameters the choices of which are communicated using TAPRegExt.

StandardsRegExt [\[SRE\]](#)

TAPRegExt uses the StandardKeyEnumeration mechanism introduced in StandardsRegExt to define controlled vocabularies.

This standard also relates to other IVOA standards:

IVOA Support Interfaces, v1.0 [\[VOSI\]](#)

VOSI describes the standard interfaces to discover metadata about services; this document describes the response TAP services should provide on the `capabilities` endpoint described by VOSI.

IVOA defined data models

Data models specified by the IVOA can define the structure of database tables holding instances of those data models. The first example of such a definition is given by [\[ObsCore\]](#). Services providing access to such tables can declare that fact within TAPRegExt instance documents.

2. The Extension

2.1. The Schema Namespace and Location

The namespace associated with TAPRegExt VOResource extensions is `http://www.ivoa.net/xml/TAPRegExt/v1.0`. Just like the namespace URI for the VOResource schema, the TAPRegExt namespace URI can be interpreted as a URL. Resolving it returns the XML schema document (given in [Appendix A](#)) that defines the TAPRegExt schema.

Authors of VOResource instance documents may choose to provide a location for the VOResource XML schema document and its extensions using the `xsi:schemaLocation` attribute. While generators are free to provide any schema location (e.g., a local mirror), this specification recommends using the TAPRegExt namespace URI as its location URL (as illustrated in the example above), as in,

```
xsi:schemaLocation="http://www.ivoa.net/xml/TAPRegExt/v1.0
http://www.ivoa.net/xml/TAPRegExt/v1.0"
```

Note that you must give the `xsi:schemaLocation` of the TAPRegExt schema when the capability defined here is part of a published registry resource record as per the IVOA Registry Interface standard [\[RI\]](#). This does not apply to the use in a TAP server's capabilities endpoint.

2.2. Declaring Instantiated Data Models

The IVOA defines certain data models that can be instantiated in database tables exposed by a TAP service. This allows a query built exclusively on a data model or a set of data models to work on all TAP services exposing tables instantiating the data model(s).

In TAPRegExt, a data model is identified by its IVORN [\[IVORN\]](#). The first example for such a data model is ObsCore [\[ObsCore\]](#).

tr:DataModelType Type Schema Definition

```
<xs:complexType name="DataModelType" >
  <xs:simpleContent >
    <xs:extension base="xs:token" >
      <xs:attribute name="ivo-id" type="vr:IdentifierURI" use="required" />
    </xs:extension>
  </xs:simpleContent>
```



```
</xs:complexType>
```

tr:DataModelType Attributes	
Attribute	Definition
ivo-id	<p><i>Value type:</i> an IVOA Identifier URI: vr:IdentifierURI</p> <p><i>Semantic:</i> The IVORN of the data model.</p> <p><i>Meaning:</i></p> <p><i>Occurrences:</i> required</p>

2.3. Languages Supported

TAP services may offer a variety of query languages. In TAPRegExt, the `language` element allows the communication of what languages are available on a service. TAP defines values of the `LANG` parameter to have either the form `<name>-<version>` or the form `<name>`, where the latter form leaves the choice of the version to the server. Therefore, a language is defined using a name and one or more versions.

The recommended way to associate larger amounts of documentation with a language entry in a capability element is via registration of the language using the mechanisms defined in [\[SRE\]](#) and associating the registry record with the language element through the latter's `ivo-id` attribute. The IVORN for the only language mandatory for TAP services, ADQL 2.0, is `ivo://ivoa.net/std/ADQL#v2.0`.

tr:Language Type Schema Definition

```
<xs:complexType name="Language" >
  <xs:sequence >
    <xs:element name="name" type="xs:NCName" />
    <xs:element name="version" type="tr:Version" minOccurs="1"
      maxOccurs="unbounded" />
    <xs:element name="description" type="xs:token" minOccurs="0" />
    <xs:element name="languageFeatures"
      type="tr:LanguageFeatureList"
      minOccurs="0"
      maxOccurs="unbounded" />
  </xs:sequence>
</xs:complexType>
```

tr:Language Metadata Elements	
Element	Definition
name	<p><i>Value type:</i> a prefixless XML name</p> <p><i>Semantic:</i> The name of the language without a version suffix.</p> <p><i>Meaning:</i></p> <p><i>Occurrences:</i> required</p>
version	<p><i>Value type:</i> a string with optional attributes</p> <p><i>Semantic:</i> A version of the language supported by the server.</p> <p><i>Meaning:</i></p> <p><i>Occurrences:</i> required; multiple occurrences allowed.</p>
description	<p><i>Value type:</i> string: xs:token</p>



tr:Language Metadata Elements	
Element	Definition
	<p><i>Semantic Meaning:</i> A short, human-readable description of the query language.</p> <p><i>Occurrences:</i> optional</p>
languageFeatures	<p><i>Value type:</i> composite: tr:LanguageFeatureList</p> <p><i>Semantic Meaning:</i> Optional features of the query language, grouped by feature type.</p> <p><i>Occurrences:</i> optional; multiple occurrences allowed.</p> <p><i>Comments:</i> This includes listing user defined functions, geometry support, or similar concepts.</p>

tr:Version Type Schema Definition

```

<xs:complexType name="Version" >
  <xs:simpleContent >
    <xs:extension base="xs:token" >
      <xs:attribute name="ivo-id" type="xs:anyURI" />
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

```

tr:Version Attributes	
Attribute	Definition
ivo-id	<p><i>Value type:</i> a URI: xs:anyURI</p> <p><i>Semantic Meaning:</i> An optional IVORN of the language.</p> <p><i>Occurrences:</i> optional</p> <p><i>Comments:</i> To more formally define a language supported by a service, a resource record for the language can be created, either centrally on the Registry of Registries or by other registry operators. When such a record exists, the language element's ivo-id should point to it.</p>

Query languages may support optional features. For ADQL, the most prominent of those are user-defined functions, i.e., functions not defined in the language standard but added by the operators of the service, and geometry functions. Such optional features may be communicated to the service client in `tr:languageFeatures` elements.

Each such list is labelled with a `type` attribute indicating the type of language option being described. This string should be an IVORN whose semantics in this context, along with the semantics of the content of its descendant `feature/form` elements, can be documented in association with the language in question.

TAPRegExt itself defines the following feature types:



ivo://ivoa.net/std/TAPRegExt#features-udf

Each feature declares a user-defined ADQL (or similar) function supported. The content of the `form` element must be the signature of the function, written to match the `signature` nonterminal in the following grammar:

```
signature ::= <funcname> <arglist> "->" <type_name>
funcname  ::= <regular_identifier>
arglist   ::= "(" <arg> { "," <arg> } ")"
arg       ::= <regular_identifier> <type_name>
```

The `type_name` nonterminal is not defined by the ADQL grammar. For the purposes of TAPRegExt, it is sufficient to assume it expands to "some sort of SQL type specifier" (which may include spaces and parentheses). For an enumeration of common types in ADQL, refer to the last column of the table in section 2.5 of [\[TAP\]](#).

Example:

```
<languageFeatures type="ivo://ivoa.net/std/TAPRegExt#features-udf">
  <feature>
    <form>match(pattern TEXT, string TEXT) -> INTEGER</form>
    <description>
      match returns 1 if the POSIX regular expression pattern
      matches anything in string, 0 otherwise.
    </description>
  </feature>
</languageFeatures>
```

ivo://ivoa.net/std/TAPRegExt#features-adqlgeo

Each feature declares support for one of the geometry functions defined by ADQL (support for these functions is in general optional for ADQL implementations, though TAP imposes some constraints on what combinations of support are permitted).

The signature of these functions, where supported, is fixed by ADQL; the content of the `form` element is just the name of the function.

Example:

```
<feature>
  <form>CONTAINS</form>
</feature>
```

tr:LanguageFeatureList Type Schema Definition

```
<xs:complexType name="LanguageFeatureList" >
  <xs:sequence >
    <xs:element name="feature" type="tr:LanguageFeature" minOccurs="0"
      maxOccurs="unbounded" />
  </xs:sequence>
  <xs:attribute name="type" type="xs:anyURI" use="required" />
</xs:complexType>
```

tr:LanguageFeatureList Metadata Elements	
Element	Definition
feature	<i>Value type:</i> composite: tr:LanguageFeature



tr:LanguageFeatureList Metadata Elements	
Element	Definition
	<p><i>Semantic Meaning:</i> A language feature of the type given by this element's type attribute.</p> <p><i>Occurrences:</i> optional; multiple occurrences allowed.</p>

tr:LanguageFeatureList Attributes	
Attribute	Definition
type	<p><i>Value type:</i> a URI: xs:anyURI</p> <p><i>Semantic Meaning:</i> The type of the features given here.</p> <p><i>Occurrences:</i> required</p> <p><i>Comments:</i> This is in general an IVORN. TAPRegExt itself gives IVORNs for defining user defined functions and geometry support.</p>

tr:LanguageFeature Type Schema Definition

```
<xs:complexType name="LanguageFeature" >
  <xs:sequence >
    <xs:element name="form" type="xs:token" />
    <xs:element name="description" type="xs:string" minOccurs="0" />
  </xs:sequence>
</xs:complexType>
```

tr:LanguageFeature Metadata Elements	
Element	Definition
form	<p><i>Value type:</i> string: xs:token</p> <p><i>Semantic Meaning:</i> Formal notation for the language feature.</p> <p><i>Occurrences:</i> required</p> <p><i>Comments:</i> The syntax for the content of this element is defined by the type attribute of its parent language list.</p>
description	<p><i>Value type:</i> string: xs:string</p> <p><i>Semantic Meaning:</i> Human-readable freeform documentation for the language feature.</p> <p><i>Occurrences:</i> optional</p>

2.4. Output Formats

A TAP service may offer a variety of output formats. What output formats are available is defined using `outputFormat` elements. They declare a MIME type [RFC2045](#) as well as aliases (the shorthand forms the server also accepts in the `FORMAT` parameter). If desired, the format can be further described with an IVORN in the `ivo-id` attribute; TAPRegExt provides keys for some variants of VOTables which are not interoperably distinguishable by their MIME types so far:



output-votable-td

A VOTable in which all DATA elements contain a TABLEDATA element

output-votable-binary

A VOTable in which all DATA elements contain a STREAM element with a BINARY child

output-votable-binary2

A VOTable in which all DATA elements contain a STREAM element with a child of the yet-to-be-defined BINARY2 VOTable element

tr:OutputFormat Type Schema Definition

```
<xs:complexType name="OutputFormat" >
  <xs:sequence >
    <xs:element name="mime" type="xs:token" />
    <xs:element name="alias" type="xs:token" minOccurs="0"
      maxOccurs="unbounded" />
  </xs:sequence>
  <xs:attribute name="ivo-id" type="xs:anyURI" />
</xs:complexType>
```

tr:OutputFormat Metadata Elements	
Element	Definition
mime	<p><i>Value type:</i> string: xs:token</p> <p><i>Semantic Meaning:</i> The MIME type of this format.</p> <p><i>Occurrences:</i> required</p> <p><i>Comments:</i> The format of this string is specified by RFC 2045. The service has to accept this string as a value of the FORMAT parameter.</p>
alias	<p><i>Value type:</i> string: xs:token</p> <p><i>Semantic Meaning:</i> Other values of FORMAT ("shorthands") that make the service return documents with the MIME type.</p> <p><i>Occurrences:</i> optional; multiple occurrences allowed.</p>

tr:OutputFormat Attributes	
Attribute	Definition
ivo-id	<p><i>Value type:</i> a URI: xs:anyURI</p> <p><i>Semantic Meaning:</i> An optional IVORN of the output format.</p> <p><i>Occurrences:</i> optional</p> <p><i>Comments:</i> When the MIME type does not uniquely define the format (or a generic MIME like application/octet-stream or text/plain is given), the IVORN can point to a key or StandardsRegExt document defining the format more precisely. To see values defined in TAPRegExt, retrieve the ivo://ivoa.net/std/TAPRegExt resource record and look for keys starting with "output-".</p>



2.5. Upload Methods

TAP services should allow the upload of VOTables. They can support various methods to do this: HTTP upload, retrieval by URL, but also VOspace or possibly retrieval using Grid protocols. Since an actual specification of the details of such protocols is far beyond the scope of a registry document and probably would not benefit clients anyway, the upload methods are given as IVORNs.

Keys for the standard upload methods are provided within the resource record `ivo://ivoa.net/std/TAPRegExt`. The keys are built by using the keys as fragment identifiers within the TAPRegExt IVORN.

It is permitted to register upload methods under authorities other than `ivoa.net`. The registry records can then provide more in-depth information. For the upload methods defined in the TAP specification, however, the IVORNs of the keys in the TAPRegExt resource record must be used to enable clients to identify supported methods using string comparisons.

This document defines the following protocol identifiers:

- `upload-inline` -- HTTP upload as per section 2.5.2 of [\[TAP\]](#).
- `upload-http` -- retrieval from an http URL.
- `upload-https` -- retrieval from an https URL.
- `upload-ftp` -- retrieval from an ftp URL.

Thus, a service offering upload by retrieving from ftp and http URLs would say:

```
<uploadMethod ivo-id="ivo://ivoa.net/std/TAPRegExt#upload-http"/>
<uploadMethod ivo-id="ivo://ivoa.net/std/TAPRegExt#upload-ftp"/>
```

tr:UploadMethod Type Schema Definition

```
<xs:complexType name="UploadMethod" >
  <xs:complexContent >
    <xs:restriction base="xs:anyType" >
      <xs:attribute name="ivo-id" type="xs:anyURI" />
    </xs:restriction>
  </xs:complexContent>
</xs:complexType>
```

tr:UploadMethod Attributes	
Attribute	Definition
ivo-id	<p><i>Value type:</i> a URI: xs:anyURI</p> <p><i>Semantic Meaning:</i> The IVORN of the upload method.</p> <p><i>Occurrences:</i> optional</p>

2.6. Resource Limits

TAP services usually impose certain limits on resource usage by clients, e.g., a maximum run time per query, or a maximum number of rows in the result set. Services assign such limits to newly created jobs and may allow raising the limits by means of queries or query parameters (e.g., the size of the result set is limited by the `MAXREC` parameter, whereas the date of job destruction may be changed by posting to the `destruction` parameter). Services may put some limit to how far the resource limitations may be raised.



TAPRegExt's capabilities element allows the declaration of such limits. These declarations are primarily intended for human consumption and should give conservative guidelines. Thus, the operators of a service implementing a complex, possibly dynamic limits policy should give lower estimates here.

If a service supports authentication and has different limits depending on what user is authenticated, it should return the limits applying to the logged user.

The resource limits applying to newly created jobs are given in `default` elements, the limits beyond which users cannot raise the limits are given in `hard` elements.

Note that the absence of a specification of limits does not imply that no limits are enforced.

Limits on Time

This document defines two time-like resource limits:

- `retentionPeriod` -- the time from job creation until destruction.
- `executionDuration` -- the maximal run time given to a query.

All values in time-like limits are given in seconds. Both `retentionPeriod` and `executionDuration` are of type `tr:TimeLimits`.

tr:TimeLimits Type Schema Definition

```
<xs:complexType name="TimeLimits" >
  <xs:sequence >
    <xs:element name="default" type="xs:integer" minOccurs="0" maxOccurs="1" />
    <xs:element name="hard" type="xs:integer" minOccurs="0" maxOccurs="1" />
  </xs:sequence>
</xs:complexType>
```

tr:TimeLimits Metadata Elements	
Element	Definition
default	<p><i>Value type:</i> integer</p> <p><i>Semantic</i> The value of this limit for newly-created jobs, given in seconds.</p> <p><i>Meaning:</i></p> <p><i>Occurrences:</i> optional</p>
hard	<p><i>Value type:</i> integer</p> <p><i>Semantic</i> The value this limit cannot be raised above, given in seconds.</p> <p><i>Meaning:</i></p> <p><i>Occurrences:</i> optional</p>

Limits on Data

Limits on data are expressed much like time limits in that they give `default` and a `hard` value as well. Both those values have a unit attribute that can either be `bytes` or `rows` for data limits.

This document defines two resource limits on data:

- `outputLimit` -- if unit is `rows` here, the `default` gives the value of TAP's `MAXREC` parameter the service will use when none is specified.



- `uploadLimit` -- the maximum size of uploads. This is not a TAP adjustable parameter. The default value advises clients about the server's wishes as to a limit above which some sort of acknowledgement should be requested from the user. The `hard` limit gives the maximum size of an upload to the server.

Data limits are defined using the `tr:DataLimits` and `tr:DataLimit` types:

tr:DataLimits Type Schema Definition

```
<xs:complexType name="DataLimits" >
  <xs:sequence >
    <xs:element name="default" type="tr:DataLimit" minOccurs="0" maxOccurs="1" />
    <xs:element name="hard" type="tr:DataLimit" minOccurs="0" maxOccurs="1" />
  </xs:sequence>
</xs:complexType>
```

tr:DataLimits Metadata Elements	
Element	Definition
default	<p><i>Value type:</i> an integer with optional attributes</p> <p><i>Semantic Meaning:</i> The value of this limit for newly-created jobs.</p> <p><i>Occurrences:</i> optional</p>
hard	<p><i>Value type:</i> an integer with optional attributes</p> <p><i>Semantic Meaning:</i> The value this limit cannot be raised above.</p> <p><i>Occurrences:</i> optional</p>

tr:DataLimit Type Schema Definition

```
<xs:complexType name="DataLimit" >
  <xs:simpleContent >
    <xs:extension base="xs:integer" >
      <xs:attribute name="unit" use="required" >
        <xs:simpleType >
          <xs:restriction base="xs:token" >
            <xs:enumeration value="bytes" />
            <xs:enumeration value="rows" />
          </xs:restriction>
        </xs:simpleType>
      </xs:attribute>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
```

tr:DataLimit Attributes	
Attribute	Definition
unit	<p><i>Value type:</i> string with controlled vocabulary</p> <p><i>Semantic Meaning:</i> The unit of the limit specified.</p> <p><i>Occurrences:</i> required</p>



tr:DataLimit Attributes	
Attribute	Definition
	<i>Allowed Values:</i> bytes, rows

2.7. The Capability Record

Using the types defined above, the `tr:TableAccess` type can be defined. Note that it is a type, not a (global) element. In instance documents, you will typically place it in a capability element with an explicit type specification, like this:

```
<capability
  xmlns:tr="http://www.ivoa.net/xml/TAP/v1.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  standardID="ivo://ivoa.net/std/TAP"
  xsi:type="tr:TableAccess">
  ...
```

By restriction from VOResource's `vr:Capability`, the `standardID` attribute of `tr:TableAccess`-typed capabilities is fixed to `ivo://ivoa.net/std/TAP` in this version. This string can be used to locate TAP services in the registry.

tr:TableAccess Type Schema Definition

```
<xs:complexType name="TableAccess" >
  <xs:complexContent >
    <xs:extension base="tr:TAPCapRestriction" >
      <xs:sequence >
        <xs:element name="dataModel" type="tr:DataModelType" minOccurs="0"
          maxOccurs="unbounded" />
        <xs:element name="language" type="tr:Language" minOccurs="1"
          maxOccurs="unbounded" />
        <xs:element name="outputFormat" type="tr:OutputFormat" minOccurs="1"
          maxOccurs="unbounded" />
        <xs:element name="uploadMethod" type="tr:UploadMethod" minOccurs="0"
          maxOccurs="unbounded" />
        <xs:element name="retentionPeriod" type="tr:TimeLimits" minOccurs="0"
          maxOccurs="1" />
        <xs:element name="executionDuration" type="tr:TimeLimits" minOccurs="0"
          maxOccurs="1" />
        <xs:element name="outputLimit" type="tr:DataLimits" minOccurs="0"
          maxOccurs="1" />
        <xs:element name="uploadLimit" type="tr:DataLimits" minOccurs="0"
          maxOccurs="1" />
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

tr:TableAccess Extension Metadata Elements	
Element	Definition
dataModel	<p><i>Value type:</i> a string with optional attributes</p> <p><i>Semantic Meaning:</i> Identifier of IVOA-approved data model supported by the service.</p> <p><i>Occurrences:</i> optional; multiple occurrences allowed.</p>



tr:TableAccess Extension Metadata Elements	
Element	Definition
language	<p><i>Value type:</i> composite: tr:Language</p> <p><i>Semantic Meaning:</i> Language supported by the service.</p> <p><i>Occurrences:</i> required; multiple occurrences allowed.</p>
outputFormat	<p><i>Value type:</i> composite: tr:OutputFormat</p> <p><i>Semantic Meaning:</i> Output format supported by the service.</p> <p><i>Occurrences:</i> required; multiple occurrences allowed.</p>
uploadMethod	<p><i>Value type:</i> composite: tr:UploadMethod</p> <p><i>Semantic Meaning:</i> Upload method supported by the service.</p> <p><i>Occurrences:</i> optional; multiple occurrences allowed.</p> <p><i>Comments:</i> The absence of upload methods indicates that the service does not support uploads at all.</p>
retentionPeriod	<p><i>Value type:</i> composite: tr:TimeLimits</p> <p><i>Semantic Meaning:</i> Limits on the time between job creation and destruction time.</p> <p><i>Occurrences:</i> optional</p>
executionDuration	<p><i>Value type:</i> composite: tr:TimeLimits</p> <p><i>Semantic Meaning:</i> Limits on executionDuration.</p> <p><i>Occurrences:</i> optional</p>
outputLimit	<p><i>Value type:</i> composite: tr:DataLimits</p> <p><i>Semantic Meaning:</i> Limits on the size of data returned.</p> <p><i>Occurrences:</i> optional</p>
uploadLimit	<p><i>Value type:</i> composite: tr:DataLimits</p> <p><i>Semantic Meaning:</i> Limits on the size of uploaded data.</p> <p><i>Occurrences:</i> optional</p>

A. The Full Schema

```
<xs:schema version="1.0" targetNamespace="http://www.ivoa.net/xml/TAPRegExt/v1.0"
  elementFormDefault="unqualified" attributeFormDefault="unqualified" xmlns:xml="http://
  www.w3.org/XML/1998/namespace" xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:vr="http://
  www.ivoa.net/xml/VOResource/v1.0" xmlns:vm="http://www.ivoa.net/xml/VOMetadata/v0.1"
  xmlns:tr="http://www.ivoa.net/xml/TAPRegExt/v1.0" xmlns:xsi="http://www.w3.org/2001/XM-
  LSchema-instance">
  <xs:annotation>
    <xs:appinfo>
```



```

<vm:schemaName>TAPRegExt</vm:schemaName>
<vm:schemaPrefix>xs</vm:schemaPrefix>
<vm:targetPrefix>tr</vm:targetPrefix>
</xs:appinfo>
<xs:documentation> A description of the capabilities metadata for TAP services.
</xs:documentation>
</xs:annotation>
<xs:import namespace="http://www.ivoa.net/xml/VOResource/v1.0" schemaLocation="http://
www.ivoa.net/xml/VOResource/VOResource-v1.0.xsd"/>
<xs:complexType name="TAPCapRestriction" abstract="true">
  <xs:annotation>
    <xs:documentation> An abstract capability that fixes the standardID to the IVOA ID for
    the TAP standard. </xs:documentation>
    <xs:documentation> See vr:Capability for documentation on inherited children.
    </xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:restriction base="vr:Capability">
      <xs:sequence>
        <xs:element name="validationLevel" type="vr:Validation" minOccurs="0"
          maxOccurs="unbounded"/>
        <xs:element name="description" type="xs:token" minOccurs="0"/>
        <xs:element name="interface" type="vr:Interface" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
      <xs:attribute name="standardID" type="vr:IdentifierURI" use="required" fixed="ivo://
        ivoa.net/std/TAP"/>
    </xs:restriction>
  </xs:complexContent>
</xs:complexType>
<xs:complexType name="TableAccess">
  <xs:annotation>
    <xs:documentation> The capabilities of a TAP server. </xs:documentation>
    <xs:documentation> The capabilities attempt to define most issues that the TAP standard
    leaves to the implementors ("may", "should"). </xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="tr:TAPCapRestriction">
      <xs:sequence>
        <xs:element name="dataModel" type="tr:DataModelType" minOccurs="0"
          maxOccurs="unbounded">
          <xs:annotation>
            <xs:documentation> Identifier of IVOA-approved data model supported by the service.
            </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="language" type="tr:Language" minOccurs="1" maxOccurs="unbounded">
          <xs:annotation>
            <xs:documentation> Language supported by the service. </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="outputFormat" type="tr:OutputFormat" minOccurs="1"
          maxOccurs="unbounded">
          <xs:annotation>
            <xs:documentation> Output format supported by the service. </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="uploadMethod" type="tr:UploadMethod" minOccurs="0"
          maxOccurs="unbounded">
          <xs:annotation>
            <xs:documentation> Upload method supported by the service. </xs:documentation>
            <xs:documentation> The absence of upload methods indicates that the service does
            not support uploads at all. </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="retentionPeriod" type="tr:TimeLimits" minOccurs="0" maxOccurs="1">
          <xs:annotation>

```



```

    <xs:documentation> Limits on the time between job creation and destruction time.
  </xs:documentation>
</xs:annotation>
</xs:element>
<xs:element name="executionDuration" type="tr:TimeLimits" minOccurs="0" maxOccurs="1">
  <xs:annotation>
    <xs:documentation> Limits on executionDuration. </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="outputLimit" type="tr:DataLimits" minOccurs="0" maxOccurs="1">
  <xs:annotation>
    <xs:documentation> Limits on the size of data returned. </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="uploadLimit" type="tr:DataLimits" minOccurs="0" maxOccurs="1">
  <xs:annotation>
    <xs:documentation> Limits on the size of uploaded data. </xs:documentation>
  </xs:annotation>
</xs:element>
</xs:sequence>
</xs:extension>
</xs:complexContent>
</xs:complexType>
<xs:complexType name="DataModelType">
  <xs:annotation>
    <xs:documentation> An IVOA defined data model, identified by an IVORN intended for machine consumption and a short label intended for human consumption. </xs:documentation>
  </xs:annotation>
  <xs:simpleContent>
    <xs:extension base="xs:token">
      <xs:attribute name="ivo-id" type="vr:IdentifierURI" use="required">
        <xs:annotation>
          <xs:documentation> The IVORN of the data model. </xs:documentation>
        </xs:annotation>
      </xs:attribute>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:complexType name="Language">
  <xs:annotation>
    <xs:documentation> A query language supported by the service. </xs:documentation>
    <xs:documentation> Each language element can describe one or more versions of a language. Either name alone or name-version can be used as values for the server's LANG parameter. </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="name" type="xs:NCName">
      <xs:annotation>
        <xs:documentation> The name of the language without a version suffix. </xs:documentation>
      </xs:annotation>
    </xs:element>
    <xs:element name="version" type="tr:Version" minOccurs="1" maxOccurs="unbounded">
      <xs:annotation>
        <xs:documentation> A version of the language supported by the server. </xs:documentation>
      </xs:annotation>
    </xs:element>
    <xs:element name="description" type="xs:token" minOccurs="0">
      <xs:annotation>
        <xs:documentation> A short, human-readable description of the query language. </xs:documentation>
      </xs:annotation>
    </xs:element>
    <xs:element name="languageFeatures" type="tr:LanguageFeatureList" minOccurs="0" maxOccurs="unbounded">
      <xs:annotation>

```




```

    <xs:documentation> Optional features of the query language, grouped by feature type.
  </xs:documentation>
  <xs:documentation> This includes listing user defined functions, geometry support, or
  similar concepts. </xs:documentation>
</xs:annotation>
</xs:element>
</xs:sequence>
</xs:complexType>
<xs:complexType name="Version">
  <xs:annotation>
    <xs:documentation> One version of the language supported by the service.
  </xs:documentation>
    <xs:documentation> If the service supports more than one version of the language, include
    multiple version elements. It is recommended that you use a version numbering scheme like
    MAJOR.MINOR in such a way that sorting by ascending character codes will leave the most
    recent version at the bottom of the list. </xs:documentation>
  </xs:annotation>
  <xs:simpleContent>
    <xs:extension base="xs:token">
      <xs:attribute name="ivo-id" type="xs:anyURI">
        <xs:annotation>
          <xs:documentation> An optional IVORN of the language. </xs:documentation>
          <xs:documentation> To more formally define a language supported by a service, a re-
          source record for the language can be created, either centrally on the Registry of
          Registries or by other registry operators. When such a record exists, the language
          element's ivo-id should point to it. </xs:documentation>
        </xs:annotation>
      </xs:attribute>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:complexType name="LanguageFeatureList">
  <xs:annotation>
    <xs:documentation> An enumeration of non-standard or non-mandatory features of a specific
    type implemented by the language. </xs:documentation>
    <xs:documentation> A feature type is a language-dependent concept like "user defined
    function", "geometry support", or possibly "units supported". A featureList gives all
    features of a given type applicable for the service. Multiple featureLists are possible.
    All feature in a given list are of the same type. This type is declared using the manda-
    tory type attribute, the value of which will typically be an IVORN. To see values defined
    in TAPRegExt, retrieve the ivo://ivoa.net/std/TAPRegExt resource record and look for keys
    starting with "features-". </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="feature" type="tr:LanguageFeature" minOccurs="0" maxOccurs="unbounded">
      <xs:annotation>
        <xs:documentation> A language feature of the type given by this element's type at-
        tribute. </xs:documentation>
      </xs:annotation>
    </xs:element>
  </xs:sequence>
  <xs:attribute name="type" type="xs:anyURI" use="required">
    <xs:annotation>
      <xs:documentation> The type of the features given here. </xs:documentation>
      <xs:documentation> This is in general an IVORN. TAPRegExt itself gives IVORNs for defin-
      ing user defined functions and geometry support. </xs:documentation>
    </xs:annotation>
  </xs:attribute>
</xs:complexType>
<xs:complexType name="LanguageFeature">
  <xs:annotation>
    <xs:documentation> A non-standard or non-mandatory feature implemented by the language..
  </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="form" type="xs:token">
      <xs:annotation>

```



```

    <xs:documentation> Formal notation for the language feature. </xs:documentation>
    <xs:documentation> The syntax for the content of this element is defined by the type
    attribute of its parent language list. </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="description" type="xs:string" minOccurs="0">
  <xs:annotation>
    <xs:documentation> Human-readable freeform documentation for the language feature.
    </xs:documentation>
  </xs:annotation>
</xs:element>
</xs:sequence>
</xs:complexType>
<xs:complexType name="OutputFormat">
  <xs:annotation>
    <xs:documentation> An output format supported by the service. </xs:documentation>
    <xs:documentation> All TAP services must support VOTable output, preserving the MIME
    type of the input. Other output formats are optional. The primary identifier for an out-
    put format is the MIME type. If you want to register an output format, you must use
    a MIME type (or make one up using the x- syntax), although the concrete MIME syntax
    is not enforced by the schema. For more detailed specification, an IVORN may be used.
    </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="mime" type="xs:token">
      <xs:annotation>
        <xs:documentation> The MIME type of this format. </xs:documentation>
        <xs:documentation> The format of this string is specified by RFC 2045. The service has
        to accept this string as a value of the FORMAT parameter. </xs:documentation>
      </xs:annotation>
    </xs:element>
    <xs:element name="alias" type="xs:token" minOccurs="0" maxOccurs="unbounded">
      <xs:annotation>
        <xs:documentation> Other values of FORMAT ("shorthands") that make the service return
        documents with the MIME type. </xs:documentation>
      </xs:annotation>
    </xs:element>
  </xs:sequence>
  <xs:attribute name="ivo-id" type="xs:anyURI">
    <xs:annotation>
      <xs:documentation> An optional IVORN of the output format. </xs:documentation>
      <xs:documentation> When the MIME type does not uniquely define the format (or a generic
      MIME like application/octet-stream or text/plain is given), the IVORN can point to a key
      or StandardsRegExt document defining the format more precisely. To see values defined in
      TAPRegExt, retrieve the ivo://ivoa.net/std/TAPRegExt resource record and look for keys
      starting with "output-". </xs:documentation>
    </xs:annotation>
  </xs:attribute>
</xs:complexType>
<xs:complexType name="UploadMethod">
  <xs:annotation>
    <xs:documentation> An upload method as defined by IVOA. </xs:documentation>
    <xs:documentation> Upload methods are always identified by an IVORN. Descriptions can be
    obtained by dereferencing this IVORN. To see values defined in TAPRegExt, retrieve the
    ivo://ivoa.net/std/TAPRegExt resource record and look for keys starting with "upload-".
    You can register custom upload methods, but you must use the standard IVORNs for the up-
    load methods defined in the TAP specification. </xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:restriction base="xs:anyType">
      <xs:attribute name="ivo-id" type="xs:anyURI">
        <xs:annotation>
          <xs:documentation> The IVORN of the upload method. </xs:documentation>
        </xs:annotation>
      </xs:attribute>
    </xs:restriction>
  </xs:complexContent>

```



```

</xs:complexType>
<xs:complexType name="TimeLimits">
  <xs:annotation>
    <xs:documentation> Time-valued limits, all values given in seconds. </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="default" type="xs:integer" minOccurs="0" maxOccurs="1">
      <xs:annotation>
        <xs:documentation> The value of this limit for newly-created jobs, given in seconds.
        </xs:documentation>
      </xs:annotation>
    </xs:element>
    <xs:element name="hard" type="xs:integer" minOccurs="0" maxOccurs="1">
      <xs:annotation>
        <xs:documentation> The value this limit cannot be raised above, given in seconds.
        </xs:documentation>
      </xs:annotation>
    </xs:element>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="DataLimits">
  <xs:annotation>
    <xs:documentation> Limits on data sizes, given in rows or bytes. </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="default" type="tr:DataLimit" minOccurs="0" maxOccurs="1">
      <xs:annotation>
        <xs:documentation> The value of this limit for newly-created jobs. </xs:documentation>
      </xs:annotation>
    </xs:element>
    <xs:element name="hard" type="tr:DataLimit" minOccurs="0" maxOccurs="1">
      <xs:annotation>
        <xs:documentation> The value this limit cannot be raised above. </xs:documentation>
      </xs:annotation>
    </xs:element>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="DataLimit">
  <xs:annotation>
    <xs:documentation> A limit on some data size, either in rows or in bytes.
  </xs:documentation>
  </xs:annotation>
  <xs:simpleContent>
    <xs:extension base="xs:integer">
      <xs:attribute name="unit" use="required">
        <xs:annotation>
          <xs:documentation> The unit of the limit specified. </xs:documentation>
        </xs:annotation>
        <xs:simpleType>
          <xs:restriction base="xs:token">
            <xs:enumeration value="bytes"/>
            <xs:enumeration value="rows"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:attribute>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
</xs:schema>

```

B. Example Document

As an example, here is an instance document as it might be part of a response from a VOSI capability endpoint or embedded within a VOResource record:



```

<capability standardID="ivo://ivoa.net/std/TAP" xsi:type="tr:TableAccess" xmlns:xm1="http://
www.w3.org/XML/1998/namespace" xmlns:tr="http://www.ivoa.net/xml/TAPRegExt/v1.0"
xmlns:vr="http://www.ivoa.net/xml/VOResource/v1.0" xmlns:vs="http://www.ivoa.net/xml/VO-
DataService/v1.1" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <interface role="std" xsi:type="vs:ParamHTTP">
    <accessURL use="base">http://localhost:8080/__system__/tap/run/tap</accessURL>
  </interface>
  <dataModel ivo-id="ivo://ivoa.net/std/ObsCore-1.0">ObsCore 1.0</dataModel>
  <language>
    <name>ADQL</name>
    <version ivo-id="ivo://ivoa.net/std/ADQL#v2.0">2.0</version>
    <description>ADQL 2.0</description>
    <languageFeatures type="ivo://ivoa.net/std/TAPRegExt#features-udf">
      <feature>
        <form>gavo_match(pattern TEXT, string TEXT) -> INTEGER</form>
        <description>gavo_match returns 1 if the POSIX regular expression pattern matches any-
        thing in string, 0 otherwise.</description>
      </feature>
    </languageFeatures>
    <languageFeatures type="ivo://ivoa.net/std/TAPRegExt#features-adqlgeo">
      <feature>
        <form>BOX</form>
      </feature>
      <feature>
        <form>POINT</form>
      </feature>
      <feature>
        <form>CIRCLE</form>
      </feature>
      <feature>
        <form>POLYGON</form>
      </feature>
      <feature>
        <form>REGION</form>
      </feature>
      <feature>
        <form>CENTROID</form>
      </feature>
      <feature>
        <form>COORD1</form>
      </feature>
      <feature>
        <form>COORD2</form>
      </feature>
      <feature>
        <form>DISTANCE</form>
      </feature>
      <feature>
        <form>CONTAINS</form>
      </feature>
      <feature>
        <form>INTERSECTS</form>
      </feature>
      <feature>
        <form>AREA</form>
      </feature>
    </languageFeatures>
  </language>
  <outputFormat ivo-id="ivo://ivoa.net/std/TAPRegExt#output-votable-binary">
    <mime>text/xml</mime>
  </outputFormat>
  <outputFormat ivo-id="ivo://ivoa.net/std/TAPRegEXT#output-votable-td">
    <mime>application/x-votable+xml;encoding=tabledata</mime>
    <alias>votable/td</alias>
  </outputFormat>
  <outputFormat>
    <mime>text/html</mime>
  </outputFormat>

```



```

    <alias>html</alias>
</outputFormat>
<outputFormat>
  <mime>application/fits</mime>
  <alias>fits</alias>
</outputFormat>
<outputFormat>
  <mime>text/csv</mime>
</outputFormat>
<outputFormat>
  <mime>text/csv;header=present</mime>
  <alias>csv</alias>
</outputFormat>
<outputFormat>
  <mime>text/tab-separated-values</mime>
  <alias>tsv</alias>
</outputFormat>
<outputFormat ivo-id="ivo://ivoa.net/std/TAPRegExt#output-votable-binary">
  <mime>application/x-votable+xml</mime>
  <alias>votable</alias>
</outputFormat>
<uploadMethod ivo-id="ivo://ivoa.net/std/TAPRegExt#upload-https"/>
<uploadMethod ivo-id="ivo://ivoa.net/std/TAPRegExt#upload-ftp"/>
<uploadMethod ivo-id="ivo://ivoa.net/std/TAPRegExt#upload-inline"/>
<uploadMethod ivo-id="ivo://ivoa.net/std/TAPRegExt#upload-http"/>
<retentionPeriod>
  <default>172800</default>
</retentionPeriod>
<executionDuration>
  <default>3600</default>
</executionDuration>
<outputLimit>
  <default unit="rows">2000</default>
  <hard unit="rows">20000000</hard>
</outputLimit>
<uploadLimit>
  <hard unit="bytes">20000000</hard>
</uploadLimit>
</capability>

```

Note that the encoding parameter in the MIME type given for the output format `ivo://ivoa.net/std/TAPRegEXT#output-votable-td` in the example is not endorsed by IVOA. Within the example, it represents a local convention.

Changes from Previous Versions

Changes from WD-20110127

- `userDefinedFunction` was generalized to feature within `languageFeatures`.
- The `uploadMethods` `StandardKeyEnumeration` was replaced by a resource record for TAPRegExt as a whole. This now includes keys of output formats and features as well; therefore, upload method names in their new IVORNs are prefixed with `upload-`
- Schema version was bumped to 1.0 (yes, we indulge in unversioned schema changes before this becomes REC).
- `uploadLimit` interpretation was changed: The default limit is now "advisory" and to be interpreted as such by clients, the hard limit is what is actually required by the server.
- There's now an optional `ivo-id` attribute on the version element within `language`.
- There's now an optional `ivo-id` attribute on output formats.



Changes from WD-20110727

- The namespace in the schema is now `http://www.ivoa.net/xml/TAPRegExt/v1.0` consistent with what has already been stated in the text.
- The IVORN for ADQL is now `ivo://ivoa.net/std/ADQL#v2.0`; it is defined here to be in ADQL's record since we do not want to wait for the ADQL standard to be fixed, but ADQL versioning should really not be done here, so a TAPRegExt IVORN is out of the question.
- The IVORN of the TAPRegExt standard is now `ivo://ivoa.net/std/TAPRegExt` to conform with other standard IVORNs. Unfortunately, this changes all other IVORNs dependent on this.
- We now allow AnyURI on the ivo-id of language to allow fragment identifiers as, e.g., in ADQL.

References

- [ADQL], Pedro Osuna and Inaki Ortiz (eds), 2008: [IVOA Astronomical Data Query Language](#), Version 2.0, IVOA Recommendation
- [IVORN], Raymond Plante (ed), 2007: [IVOA Identifiers](#), Version 1.12, IVOA Recommendation
- [ObsCore] Doug Tody, Alberto Micol, Daniel Durand, and Mireille Louys (eds.), 2011: [Observation Data Model Core Components and its Implementation in the Table Access Protocol](#), Version 1.0, IVOA Recommendation
- [REGWG] Various: [Registry Working Group home page](#).
- [RFC2045], N. Freed and N. Borenstein, 1996: [Multipurpose Internet Mail Extensions \(MIME\) Part One: Format of Internet Message Bodies](#), IETF RFC 2045
- [RI] Kevin Benson, Ray Plante, Elizabeth Auden, Matthew Graham, Gretchen Greene, Marin Hill, Tony Linde, Dave Morris, Wil O'Mullane, Guy Rixon, Kona Andrews, 2008: [IVOA Registry Interfaces](#), Version 1.0, IVOA Recommendation
- [SCHEMA] [IVOA Schema Collection](#)
- [SRE] Paul Harrison (ed), et al, 2010: [StandardsRegExt: a VOResource Schema Extension for Describing IVOA Standards](#), Version 1.0, IVOA Recommendation
- [TAP] Patrick Dowler, Guy Rixon, Doug Tody, 2010: [Table Access Protocol](#), Version 1.0, IVOA Recommendation
- [UWS] Paul Harrison and Guy Rixon, 2010: [Universal Worker Service Pattern](#), Version 1.0, IVOA Recommendation
- [VOR] Raymond Plante, Kevin Benson, Matthew Graham, Gretchen Greene, Paul Harrison, Gerard Lenson, Tony Linde, Guy Rixon, Aurelien Stebe, 2008: [VOResource: an XML Encoding Schema for Resource Metadata](#), Version 1.03, IVOA Recommendation
- [VOSI] Matthew Graham, Ray Plante, Guy Rixon (eds), 2011: [IVOA Support Interfaces](#) Version 1.0, IVOA Recommendation
- [XSD] David C. Fallside, and Priscilla Walmsley, 2004: [XML Schema Part 0: Primer Second Edition, W3C Recommendation](#)