

WS-Iterator 1.0

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Abstract

A number of grid services aggregate data together in lists or maps as part of their inherent function. Consider RNS (the Resource Namespace Specification) [**RNS**] which provides the means of mapping human readable names to resource endpoints. Also consider a grid queue or cluster management system which might both group together target or backend BESs (Basic Execution Services) [**BES**] as well as provide mechanisms for querying or manipulating lists of queued jobs. Numerous other examples exist. In both of these cases, it is unreasonable and inefficient to expect communication where the entire contents of such a group is transferred in a single SOAP [**SOAP1.1**] document. At the same time, given the potentially large and diverse spectrum of likely uses for which iteration might be ideal, a generic form of iteration is desirable – one for which iterable content is extensible.

There are iteration service specifications available already, in particular WS-Enumeration provides a similar functionality. Unfortunately, WS-Enumeration [**WS-Enumeration**] is based off of an entirely different model of web service endpoint interaction than that of WSRF. In particular, while WSRF has adopted this notion of the “implied” target resource as identified by WS-Addressing [**WS-Addressing**] information included in the request message's SOAP headers, WS-Enumeration uses a more service oriented, “token-in-the-soap-body” protocol. As such, in cases where grid service design is heavily influenced by and modeled after a WSRF pattern, WS-Enumeration is confusing and ungainly. In those cases, WS-Iterator provides the same functionality in a way that is more consistent with intended WSRF practices.

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1 Introduction

A number of grid services aggregate data together in lists or maps as part of their inherent function. Consider RNS (the Resource Namespace Specification) which provides the means of mapping human readable names to resource endpoints. Also consider a grid queue or cluster management system which might both group together target or backend BESs (Basic Execution Services) as well as provide mechanisms for querying or manipulating lists of queued jobs. Numerous other examples exist. In both of these cases, it is unreasonable and inefficient to expect communication where the entire contents of such a group is transferred in a single SOAP document. At the same time, given the potentially large and diverse spectrum of likely uses for which iteration might be ideal, a generic form of iteration is desirable – one for which the iterable content is extensible.

There are iteration service specifications available already, in particular WS-Enumeration provides a similar functionality. Unfortunately, WS-Enumeration is based off of an entirely different model of web service endpoint interaction than that of WSRF. In particular, while WSRF has adopted this notion of the “implied” target resource as identified by WS-Addressing information included in the request message's SOAP headers, WS-Enumeration uses a more service oriented, “token-in-the-soap-body” protocol. As such, in cases where grid service design is heavily influenced by and modeled after a WSRF pattern, WS-Enumeration is confusing and ungainly. In those cases, WS-Iterator provides the same functionality in a way that is more consistent with intended WSRF practices.

1.1 Outline for this Document

The remainder of this document will be organized as follows. First, we will present a high level overview of the port type we recommend for the WS-Iterator specification. We will follow this with sections which drill down into the details of the port type. Because this specification is specific to a WSRF style of rendering, it is possible to provide normative message examples and WSDL¹ and those components will be included. Finally, we will summarize the information in this document and wrap up with information about security considerations, author information, and glossary terms.

1.2 Terminology

The keywords “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

In addition to the terms introduced in [RFC2119], additional terms commonly used in this document are defined in the Glossary in the back.

¹ This specification document is modeled after the OGSA ByteIO specification document. However, in the case of ByteIO, the port types described were described in a rendering agnostic way (they did not require WSRF or any other specific OGSA Basic Profile rendering). Rather, ByteIO expects that various “rendering” documents will be provided to augment and complete the rendering neutral specification.

When describing abstract data models, this specification uses the notational convention used by the **[XML Infoset]**.

When describing concrete XML schemas, this specification uses the notational convention of **[WS-Security]**. Specifically, each member of an element's [children] or [attributes] property is described using an Xpath-like **[XPath]** notation (e.g., /x:MyHeader/x:SomeProperty@value1). The use of {any} indicates the presence of an element wildcard (<xsd:any/>). The use of @{any} indicates the presence of an attribute wildcard (<xsd:anyAttribute/>).

1.3 Namespaces

The following namespaces are used in this document:

Prefix	Namespace
s11	http://schemas.xmlsoap.org/soap/envelope
xsd	http://www.w3.org/2001/XMLSchema
wsa	http://www.w3.org/2005/08/addressing
iterator	http://schemas.ogf.org/ws-iterator/2008/06/iterator

2 WS-Iterator Port Type

The WS-Iterator port type is a very simple port type consisting of exactly one operation (for retrieving a range of contained elements) and a number of resource properties describing the contained elements. Further, as an OGSA Basic Profile compliant service port type, it requires the addition of a handful of other WSRF specifications. Specifically, all web services which implement the WS-Iterator port type **MUST** also be compliant with the OGSA WSRF Basic Profile 1.0 **[WSRFProfileDoc]** which requires the service to implement a number of other WSRF port types having to do with resource properties and service resource lifetime.

2.1 WS-Iterator Interface

The WS-Iterator port allows clients to retrieve small subsets of a stored set of arbitrary XML documents. It is up to other specifications which make use of WS-Iterator to define the exact contents of these contained documents. The WS-Iterator interface is conceptually defined as follows:

WS-Iterator
elementCount: unsignedLong
preferredBlockSize: unsignedInt
iterate(startOffset: unsignedLong, elementCount: unsignedInt): IterableElement

2.1.1 WS-Iterator elementCount Property

The elementCount property is a required WSRF Resource Property describing the total number of elements contained within this iterator. This WSRF Resource Property has a cardinality of exactly 1.

2.1.2 WS-Iterator preferredBlockSize Property

The preferredBlockSize property is an optional WSRF Resource Property describing the preferred number of elements that a client should ask for in any one request. This WSRF Resource Property has a cardinality of [0, 1].

2.2 WS-Iterator iterate Operation

The iterate operation is used by clients who wish to retrieve a subset of the elements stored within a given iterator. The WS-Iterator **MUST** respond to an iterate request message with an iterateResponse message. The iterator **MAY** respond with fewer elements than requested, however doing so **MUST** indicate that the last element available from the iterator has been reached and that no elements beyond the last one returned in the result message are available.

2.2.1 WS-Iterator iterate

The format of the iterate Message is:

```
...
<iterator:iterate>
  <iterator:start-offset> xsd:unsignedLong </iterator:start-offset>
  <iterator:element-count> xsd:unsignedInt </iterator:element-count>
</iterator:iterate>
...
```

The components of the iterate message are further described as follows:

/iterator:start-offset

This element gives the index of the first element (0-based) within the iterator resource for which the client wishes to obtain a subset.

/iterator:element-count

This element gives the maximum number of elements that the client wishes to retrieve from the target iterator resource. The iterator **MAY** return fewer elements than specified, but only if the

missing elements are not contained within the target resource (in other words, it is not an error to request more elements than the iterator contains, but the iterator **MUST** respond with a short count indicating this condition).

The response to the iterate message is a message of the form:

```
...
<iterator:iterateResponse>
  <iterator:iterable-element index="xsd:unsignedInt">
    {any} *
  </iterator:iterable-element> *
</iterator:iterateResponse>
...
```

The components of the iterateResponse message are further described as follows:

`/iterator:iterable-element`

This element represents a single element of data stored by the iterator. The contents of this element are the exact documents stored as a single element within the iterator.

`/iterator:iterable-element@index`

This property indicates the global index of the element represented by this iterable element. This index is 0-based and **MUST** be consecutively numbered withing the response message.

2.2.2 Example SOAP Encoding of the iterate Message Exchange

The following is a non-normative example of an iterate request message using **[SOAP1.1]**:


```
<s11:Envelope
  xmlns:s11="http://www.w3.org/2003/05/soap-envelope"
  xmlns:iterator="http://schemas.ogf.org/ws-iterator/2008/06/iterator">
  <s11:Header>
    <wsa:Action>
      http://schemas.ogf.org/ws-iterator/2008/06/iterator/iterate
    </wsa:Action>
    <wsa:To s11:mustUnderstand="1">
      http://tempuri.org/iterator-source
    </wsa:To>
  </s11:Header>

  <s11:Body>
    <iterator:iterate>
      <iterator:start-offset>1000</iterator:start-offset>
      <iterator:element-count>5</iterator:element-count>
    </iterator:iterate>
  </s11:Body>
</s11:Envelope>
```

The following is a non-normative example of an iterate response message using **[SOAP1.1]**:

```

<s11:Envelope
  xmlns:s11="http://www.w3.org/2003/05/soap-envelope"
  xmlns:iterator="http://schemas.ogf.org/ws-iterator/2008/06/iterator">
  <s11:Header>
    <wsa:Action>
      http://schemas.ogf.org/ws-iterator/2008/06/iterator/iterateResponse
    </wsa:Action>
    <wsa:To s11:mustUnderstand="1">
      http://schemas.xmlsoap.org/ws/2004/03/addressing/role/anonymous
    </wsa:To>
  </s11:Header>

  <s11:Body>
    <iterator:iterateResponse>
      <iterator:iterable-element index="1000">
        <ns1:user-info xmlns:ns1="http://tempuri.org/some-namespace">
          some unknown content
        </ns1:user-info>
      </iterator:iterable-element>
    </iterator:iterateResponse>
  </s11:Body>
</s11:Envelope>

```

3 WS-Iterator Properties²

The following table indicates the properties that WS-Iterator resources contain. The *Requirement Level* entry in the table describes whether a WS-Iterator resource **MUST** have the property, **SHOULD** have the property, or **MAY** have the property (as per **[RFC2119]**). This list is by no means exhaustive and implementors are free to add their own properties as they see fit.

Property	Requirement Level	Description
elementCount	MUST	The total number of elements contained in the target WS-Iterator resource.
preferredBlockSize	MAY	The preferred number of elements to retrieve in any given iterate request message.

² These resource properties are in addition to any resource properties required or specified by the OGSA WSRF Basic Profile 1.0 on which this specification is dependent.

These properties are further described normatively as follows:

```
...
  targetNamespace="http://schemas.ogf.org/ws-iterator/2008/06/iterator"
...
  <xsd:element name="elementCount" type="xsd:unsignedLong"
    minOccurs="1" maxOccurs="1"/>
  <xsd:element name="preferredBlockSize" type="xsd:unsignedInt"
    minOccurs="0" maxOccurs="1"/>
```

4 Faults and Failures

The WS-Iterator port type requires no faults or failure messages beyond those indicated by WSRF and by the OGSA WSRF Basic Profile 1.0. Any client requesting an invalid range of elements will simply receive an empty response message. Any client requesting more elements than the iterator has available will receive an appropriately truncated response message.

5 Static versus Dynamic Content

While it is anticipated that most services or port types that make use of the WS-Iterator port type will instantiate static or “snapshot” instances (i.e., resources of WS-Iterators which can iterate over a static snapshot of another resources state or view of that state), this author sees no reason to outright prohibit the creation of a WS-Iterator with dynamic content. It is expected (though no normative declarations will be made here) that such a “dynamic” iterator would have the following properties:

- A client asking for a specific subset of the iterator's elements might receive different results from one invocation of the iterate operation to the next
- A client asking for a specific subset of the iterator's elements might receive different numbers of resultant elements from one invocation of the iterate operation to the next (though never in a way that violates the requirement that a WS-Iterator which returns a short count of elements is indicating that the result contains the last available iterable element at that point in time).
- The resource property describing a target iterator's contents might change over time
- Some form of notification about an iterator's contents changing should be available

6 Security Considerations

Security is, of course, important for WS-Iterators. Considering that WS-Iterators will likely be used by service port type implementations to return sets or lists of data that might, in their own right, be considered sensitive, WS-Iterators will likely (though not required by this specification) inherit the security requirements of their source resources. However, as always, security is a cross-cutting concern here and as such specification thereof lies outside the purview of this document.

7 Author Information

Editor:
Mark Morgan
University of Virginia, Department of Computer Science
151 Engineer's Way
P.O. Box 400740
Charlottesville, VA. 22904-4740
Phone: +1 (434) 243-2175
E-mail: mmm2a@virginia.edu

8 Glossary

Conceptual Interface An interface which describes the conceptual behavior of a service but which doesn't necessarily reflect the actual parameters and methods that are being received and sent.

9 Intellectual Property Statement

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10 References

- [WSRFProfileDoc] I. Foster, T. Maguire, D. Snelling, *OGSA WSRF Basic Profile 1.0*, <https://forge.gridforum.org/projects/ogsa-wg/document/draft-ggf-ogsa-wsrf-basic-profile/en/15>, GWS-R (draft-ggf-ogsa-wsrf-basic-profile-021), 6 July 2005.
- [RFC2119] S. Bradner, *Key words for use in RFCs to Indicate Requirement Levels*, <http://www.ietf.org/rfc/rfc2991.txt>, IETF RFC 2119, March 1997.
- [XML-Infoset] <http://www.w3.org/TR/xml-infoset/>
- [XPath] <http://www.w3.org/TR/xpath>
- [WS-Addressing] M. Gudgin, M. Hadley, and T. Rogers (ed.), *Web Services Addressing 1.0 – Core (WS-Addressing)*, 9 May 2006, <http://www.w3.org/TR/2006/REC-ws-addr-core-20060509>
- [WS-Enumeration] <http://www.w3.org/Submission/WS-Enumeration/>
- [ByteIOSpec] M. Morgan (ed.), *ByteIO Specification 1.0*, <http://www.ggf.org/documents/GFD.88.pdf>, GFD.88, 31 October 2006.
- [ByteIOWSRFRend] M. Morgan (ed.), *ByteIO OGSA WSRF Basic Profile Rendering 1.0*, <http://www.ggf.org/documents/GFD.87.pdf>, GFD.87, 31 October 2006.
- [BES] <http://www.ggf.org/documents/GFD.108.pdf>
- [SOAP1.1] <http://www.w3.org/TR/soap11>

GFD-Unknown

27 June 2008

[RNS]

<http://www.ggf.org/documents/GFD.101.pdf>

Appendix A: WS-Iterator Schema

```

<?xml version="1.0" encoding="UTF-8"?>
<!--
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NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL
NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR
FITNESS FOR A PARTICULAR PURPOSE.
-->
<xsd:schema
  xmlns="http://schemas.ogf.org/ws-iterator/2008/06/iterator"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:iterator="http://schemas.ogf.org/ws-iterator/2008/06/iterator"
  xmlns:wsbf="http://docs.oasis-open.org/wsrf/bf-2"
  targetNamespace="http://schemas.ogf.org/ws-iterator/2008/06/iterator"
  elementFormDefault="qualified"
  attributeFormDefault="unqualified">

  <xsd:import
    namespace="http://docs.oasis-open.org/wsrf/bf-2"
    schemaLocation="http://docs.oasis-open.org/wsrf/bf-2.xsd"/>

```

```
<!-- Resource Property Related -->
  <xsd:element name="elementCount" type="xsd:unsignedLong"/>
  <xsd:element name="preferredBlockSize" type="xsd:unsignedInt"/>

<!-- Message Related -->
  <xsd:complexType name="IterableElementType">
    <xsd:sequence>
      <xsd:any namespace="##other" processContents="lax"
        minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="index" type="xsd:unsignedInt"
      use="required"/>
  </xsd:complexType>

<!-- Message Types -->
  <xsd:complexType name="IterateRequestType">
    <xsd:sequence>
      <xsd:element name="start-offset" type="xsd:unsignedLong"
        minOccurs="1" maxOccurs="1"/>
      <xsd:element name="element-count" type="xsd:unsignedInt"
        minOccurs="1" maxOccurs="1"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="IterateRequestType" type="iterator:IterateRequestType"/>

  <xsd:complexType name="IterateResponseType">
    <xsd:sequence>
      <xsd:element name="iterable-element" type="iterator:IterableElementType"
        minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="IterateResponseType"
    type="iterator:IterateResponseType"/>
</xsd:schema>
```

Appendix B: WS-Iterator WSDL

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<!--
```

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```
-->
```

```
<wsdl:definitions
```

```
  name="WSIterator"
```

```
  xmlns="http://schemas.ogf.org/ws-iterator/2008/06/iterator"
```

```
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
```

```
  xmlns:iterator="http://schemas.ogf.org/ws-iterator/2008/06/iterator"
```

```
  xmlns:wsbf="http://docs.oasis-open.org/wsrp/bf-2"
```

```
  xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
```

```
  xmlns:genii-common="http://vcgr.cs.virginia.edu/genii/2006/12/common"
```

```
  xmlns:rpw-2="http://docs.oasis-open.org/wsrp/rpw-2"
```

```
  xmlns:rw-2="http://docs.oasis-open.org/wsrp/rw-2"
```

```
  xmlns:wsrp="http://docs.oasis-open.org/wsrp/rp-2"
```

```
  xmlns:wsrpw="http://docs.oasis-open.org/wsrp/rpw-2"
```

```
xmlns:wsrf-r="http://docs.oasis-open.org/wsrf/r-2"
xmlns:wsrf-rw="http://docs.oasis-open.org/wsrf/rw-2"
xmlns:wSDL="http://schemas.xmlsoap.org/wSDL/"
targetNamespace="http://schemas.ogf.org/ws-iterator/2008/06/iterator">

<wSDL:import
  namespace="http://docs.oasis-open.org/wsrf/rw-2"
  location="http://docs.oasis-open.org/wsrf/rw-2.wSDL"/>

<wSDL:import
  namespace="http://docs.oasis-open.org/wsrf/rpw-2"
  location="http://docs.oasis-open.org/wsrf/rpw-2.wSDL"/>

<wSDL:import
  namespace="http://docs.oasis-open.org/wsrf/rlw-2"
  location="http://docs.oasis-open.org/wsrf/rlw-2.wSDL"/>

<wSDL:types>
  <xSD:schema
    xmlns:xSD="http://www.w3.org/2001/XMLSchema"
    attributeFormDefault="unqualified"
    elementFormDefault="qualified"
    targetNamespace="http://schemas.ogf.org/ws-iterator/2008/06/iterator">

    <xSD:import
      namespace="http://schemas.ogf.org/ws-iterator/2008/06/iterator"
      schemaLocation=".iterator.xSD"/>

    <xSD:import
      namespace="http://docs.oasis-open.org/wsrf/bf-2"
      schemaLocation="http://docs.oasis-open.org/wsrf/bf-2.xSD"/>

    <xSD:import
      namespace="http://docs.oasis-open.org/wsrf/rp-2"
      schemaLocation="http://docs.oasis-open.org/wsrf/rp-2.xSD"/>

    <xSD:import
      namespace="http://docs.oasis-open.org/wsrf/rl-2"
      schemaLocation="http://docs.oasis-open.org/wsrf/rl-2.xSD"/>
  </xSD:schema>

<!-- == Resource Property Related == -->
  <xSD:element name="WSIteratorRP">
    <xSD:complexType>
```

```
        <xsd:sequence>
            <xsd:any namespace="##other" minOccurs="0"
                maxOccurs="unbounded"/>
            <xsd:element ref="iterator:elementCount"
                minOccurs="1" maxOccurs="1"/>
            <xsd:element ref="iterator:preferredBlockSize"
                minOccurs="0" maxOccurs="1"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
</wsdl:types>

<wsdl:message name="IterateRequest">
    <wsdl:part name="IterateRequest"
        element="iterator:IterateRequestType"/>
</wsdl:message>

<wsdl:message name="IterateResponse">
    <wsdl:part name="IterateResponse"
        element="iterator:IterateResponseType"/>
</wsdl:message>

<wsdl:portType name="WSIteratorPortType"
    wsrp:ResourceProperties="iterator:WSIteratorRP">

<!-- extends wsrpw:ResourceProperties-->
<!-- extends wsrlw:ImmediateTerminate-->
<!-- extends wsrlw:ScheduledTermination-->

    <wsdl:operation name="iterate">
        <wsdl:input message="iterator:IterateRequest"/>
        <wsdl:output message="iterator:IterateResponse"/>
    </wsdl:operation>
</wsdl:portType>

</wsdl:definitions>
```