



## NextGRID Data Access Profile

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## 1 Introduction

This document defines the NextGRID Data Access Profile 1.0 (hereafter, “this Profile”), consisting of a set of de facto, institutional or evolving institutional Web Services specifications, along with clarifications, refinements, interpretations and amplifications of those specifications that promote interoperability among implementations of those specifications.

Section 1 introduces this Profile, and explains its relationships to other profiles.

Section 2, “Profile Conformance”, explains what it means to be conformant to this Profile.

Subsequent sections present the requirements for a NextGRID data access service and prescribe the Data Access Profile in terms of extensions to NextGRID and other profiles.

This Profile forms part of the NextGRID Generalized Specifications, which aim at capturing NextGRID architectural concepts in a set of profiles that may be composed together. These profiles are specified in such a way that they could be implemented in terms of other well known specifications. While overall consistency is achieved at the conceptual level, and captured through the motivating Use Cases accompanying each Generalized Specification, system implementations, which may be based on other specifications, may not be consistent with this Profile. Thus, each profile defines a realisation of the underlying concept that can be implemented. However, implementers of the NextGRID architecture may need to support multiple underlying specifications.

### 1.1 Profile Overview

This Profile is intended for use when implementing data access services that are in line with the concepts of NextGRID [1]. It mandates adherence to a certain set of specifications and clarifies their use. A service implementation that uses those specifications in a manner conformant with this Profile may be said to be an “implementation of the NextGRID Data Access Profile 1.0” or, informally, to be a “NextGRID Data Access Service”.

The primary issues addressed in this Profile are as follows:

- The specification of NextGRID data access in terms of the core OGSA ByteIO specification and its WSRF rendering.
- The specification of NextGRID data access in terms of the core OGSA WS-DAI specification.
- The relation between the NextGRID Data Access and Data Storage Profiles.

### 1.2 Relationships to Other Profiles

This Profile extends the *NextGRID Basic Profile* 1.0 [2].



## NextGRID Data Storage Profile

This Profile complements the *NextGRID Data Storage Profile* [3].

## NextGRID Naming Profile

Service naming conforms to the *NextGRID Naming Profile* [4].

## NextGRID Data Transfer Profile

To access (that is, input or output) data from a data storage service, the storage service needs to be able to act as either a sink or a source of data within the context of the *NextGRID Data Transfer Profile* [5].

## OGSA ByteIO Specification

This Profile specifies data access in terms of the OGSA *ByteIO Specification* [6] and the *ByteIO WSRF Basic Profile Rendering* [7].

## OGSA WS-DAI Core Specification

This Profile also specifies data access in terms of the OGSA WS-DAI Core Specification [8].

## 1.3 Relationship to Use Cases

This Profile represents mappings from the use cases described in the *NextGRID Data Storage and Access Use Cases* document [9] to the Web Services Resource Framework (WSRF) technology [10]. These mappings are specified using the *ByteIO Specification* [6], the *ByteIO WSRF Basic Profile Rendering* [7] and the OGSA WS-DAI Core Specification [8].

### 1.3.1 Terminology

This Profile adopts the terminology of the *NextGRID Data Storage and Access Use Cases and Requirements* [9]. See that document, particularly Section 1.3 ‘Terminology’, for descriptions of the terms pertaining to data processing used in this Profile. Hereafter terms defined in that section of that document are shown in **bold** in this Profile. See also the OGSA *Glossary of Terms* [11].



## 1.4 Notational Conventions

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC2119 [12].

Normative statements of requirements in this Profile are presented in the manner detailed in the *WS-I Basic Profile 1.1* [13], Section 2.1, “Conformance Requirements”.

Both requirement statements and extensibility statements can be considered namespace-qualified. This specification uses a number of namespace prefixes throughout; their associated URIs are listed below. Note that the choice of any namespace prefix is arbitrary and not semantically significant.

**Table 1 Namespaces used by NextGRID Data Access Profile 1.0.**

Prefix	Namespace
wsdl	http://schemas.xmlsoap.org/wsdl

## 1.5 Profile Identification and Versioning

Profile identification and versioning use the style described in the *WS-I Basic Profile 1.1* [13] and abide by the normative descriptions contained therein. The name of this Profile is “NextGRID Data Access Profile” and the version number is “1.0”.

## 2 Profile Conformance

Conformance to this Profile is defined normatively in the *WS-I Basic Profile 1.1* [13], Section 2, “Profile Conformance”. This Profile abides by those definitions.

### 2.1 Conformance Targets

Since this Profile is an extension of the *NextGRID Basic Profile 1.0* [2], which itself extends the *WS-I Basic Profile 1.1* [13] and the *OGSA WSRF Basic Profile 1.0* [14], it may place further restrictions on conformance targets defined therein.

The following conformance targets are used in this Profile:

- **INSTANCE** – an instance of an implementation of a NextGRID data access service; such an instance necessarily implements a wsdl:port (from *WS-I Basic Profile 1.1*, without “bindingTemplate” from the namespace urn:uddi-org:api\_v2).

- **BYTEIOINSTANCE**– an INSTANCE which implements data access according to the ByteIO standard.
- **WSDAIINSTANCE** – an INSTANCE which implements data access according to the WS-DAI standard.
- **DATASET** – a NextGRID **dataset** to be accessed by a NextGRID data access service.

## 2.2 Claiming Conformance

Claims of conformance to this Profile and the attachments mechanisms are the same as normatively described in the *WS-I Basic Profile 1.1* [13].

The conformance claim URI for this Profile is “<http://www.nextgrid.org/dataaccessprofile/v-1>”.

## 3 NextGRID Data Access

### 3.1 NextGRID Datasets

A **dataset** in the context of NextGRID is ‘any identifiable collection of data; that is, one which can be uniquely and independently identified by a NextGRID name (see the *NextGRID Naming Profile* [4]) or referenced with an EPR’. The *NextGRID Data Storage and Access Use Cases and Requirements* [10], Section 1.3 and 1.4, pp4-5 gives further details.

**Datasets** may be instantiated in more than one way. Specifically, they may be **files** or **selections**:

- A **file** is a **dataset** instantiated as a file in some operating system.
- A **selection** is a **dataset** instantiated as a set of tuples in some database which satisfy some criterion. A **selection** may be: (i) a whole database, (ii) a table in a database, or (iii) a selection of tuples from one or more tables in a database (that is, a view).

### 3.2 Data Access and Data Storage

**Data storage** is the persistence of data through time. A NextGRID **data storage service**, or a **store**, superintends the storage of **datasets**. Amongst other functions it provides **access** to the **datasets** that it is storing.

In addition to **data storage services**, other sorts of NextGRID services may also provide **access** to transient **datasets**. For example: data processing services [15] may provide **access** to **datasets** that they have computed or services superintending data-feeds or sensors may provide **access** to real-time measurements.

See also the *NextGRID Data Storage and Access Use Cases and Requirements* [9], Section 1.5, p5.

### 3.3 Data Access Functionality

Access to a **dataset** includes the following functionality:

- Query (or locate, or find) a **dataset**.
- Read a **dataset**.
- Write a **dataset**.
- Update a **dataset**.
- Delete a **dataset**.

These basic operations are common to all **datasets**, though the details may vary somewhat depending on whether the **datasets** are **files** or **selections**. The *NextGRID Data Storage and Access Use Cases and Requirements* [9] gives various examples.

### 3.4 Mapping to WSRF

NextGRID services are specified as a set of services mapped to the WSRF (Web Services Resource Framework) [10]. NextGRID data access is mapped to WSRF using either of two alternative specifications, both developed by the OGF (Open Grid Forum) OGSA (Open Grid Services Architecture) effort:

- The *ByteIO Specification* [6] and its rendering into WSRF [7]. The ByteIO specifications are adopted as described in Section 5, below.
- The WS-DAI (Web Services Data Access and Integration) specifications [16], specifically, *The Core (WS-DAI) Specification* [8]. The WS-DAI specifications are adopted as described in Section 6, below.

### 3.5 ByteIO and WS-DAI

ByteIO and WS-DAI are alternatives which provide contrasting interfaces to access a **dataset**. ByteIO is designed to provide Web services with POSIX-like [17] access to remote data resources, whereas WS-DAI provides access similar to that for relational databases. Neither specification constrains the actual implementation of the underlying **dataset**; in principle the two specifications could be used to access the same **dataset**. The difference is simply in the functionality and facilities of the interface.

Strictly speaking, both ByteIO and WS-DAI access not just static **datasets** but ‘data resources’ which may be any source of data, in principle including live data streams from sensors *etc.* or transient data generated by computation.

A NextGRID data access service must support data transfer using the *NextGRID Data Transfer Profile* [5], which, in turn, requires that at least some parts of ByteIO are supported (see Section 6,

below). Therefore a NextGRID data access service must support these parts of ByteIO. It may also support WS-DAI and those parts of ByteIO not mandated by the *NextGRID Data Transfer Profile*. Consequently:

**R0351** An INSTANCE MUST support at least those parts of ByteIO mandated by the NextGRID Data Transfer Profile [5].

**R0352** An INSTANCE MAY support those parts of ByteIO not mandated by the NextGRID Data Transfer Profile [5].

**R0353** An INSTANCE MAY support WS-DAI.

For precision it is useful to distinguish the following terminology:

- An INSTANCE which supports ByteIO is a BYTEIOINSTANCE; every INSTANCE is a BYTEIOINSTANCE.
- An INSTANCE which supports WS-DAI is a WSDAIINSTANCE.
- An INSTANCE which supports both ByteIO and WS-DAI is simultaneously a BYTEIOINSTANCE and a WSDAIINSTANCE.

## 4 NextGRID Basic Profile

This section of the Profile incorporates the following specification by reference:

- *NextGRID Basic Profile 1.0* [2].

All requirements stated in the *NextGRID Basic Profile 1.0* must be observed by implementations of this Profile.

## 5 OGSA ByteIO

This section of the Profile incorporates sections of the following specifications by reference:

- *OGSA ByteIO Specification* [6],
- *ByteIO OGSA WSRF Basic Profile Rendering* [7].

### 5.1 Mapping to WSRF

The *OGSA ByteIO Specification* [6] defines the ByteIO functionality in a manner independent of its mapping to any OGSA basic profile. The *ByteIO OGSA WSRF Basic Profile Rendering* [7] defines the mapping of this abstract specification to the WSRF framework via the *OGSA WSRF Basic Profile* [14]. Currently the *OGSA WSRF Basic Profile* is the only basic profile defined by

OGSA and *ByteIO OGSA WSRF Basic Profile Rendering* is the only ByteIO rendering. However, it is anticipated that additional basic profiles and renderings will be defined in the future.

NextGRID profiles are also ultimately defined in terms of the *OGSA WSRF Basic Profile*, via the *NextGRID Basic Profile* [2]. Therefore, irrespective of any additional basic profiles and renderings that might subsequently be defined:

**R0511** A *BYTEIOINSTANCE* MUST conform to the ByteIO OGSA WSRF Basic Profile Rendering [7].

## 5.2 *RandomByteIO* and *StreamableByteIO*

ByteIO supports two different methods for accessing a **dataset**: *RandomByteIO* and *StreamableByteIO*. Each method is implemented as a separate port type. Briefly:

- **RandomByteIO** gives direct random access to a portion of a **dataset**. The portion is specified by giving an offset (in bytes) from the start of the **dataset** and the number of bytes required. Each read or write operation is independent of any previous operations and can access any portion of the **dataset**.
- **StreamableByteIO** gives streamed access to a **dataset**, with each access relative to the previous access. Each read or write operation is performed relative to the current position of a pointer in the stream, and this pointer is updated as the operation completes.

The *ByteIO Specification* [6] does not explicitly state whether or not a ByteIO service must support both *RandomByteIO* and *StreamableByteIO* access, but implies that it does not have to.

The *NextGRID Data Transfer Profile* [5] requires that services which provide NextGRID data transfer must support the ByteIO *RandomByteIO* port type (Section 6.1.1). NextGRID data access services require the functionality defined in the *NextGRID Data Transfer Profile*, so they too must support the ByteIO *RandomByteIO* port type. Conversely, support for ByteIO *StreamableByteIO* access is not mandatory. Thus:

**R0521** A *BYTEIOINSTANCE* MUST support the *RandomByteIO* port type.

**R0522** A *BYTEIOINSTANCE* MAY support the *StreamableByteIO* port type.

## 5.3 *Lifetime Management*

The *ByteIO Specification* [6] prescribes services to access **datasets**. In addition to providing read, write and update access to the **datasets** it may be necessary to open and close such access, or alternatively, to create and destroy access. These concepts are discussed under the rubric ‘lifetime management.’ The *ByteIO Specification* notes that:

- Opening (or creating) access to a **dataset** is outside the scope of the ByteIO specification, though some optional recommendations are given.
- Closing (or destroying) access to a **dataset** is within the scope of the specification and the behaviour is specified. This behaviour (i) differs between RandomByteIO and StreamableByteIO access and (ii) may vary with the rendering.

For convenience the specified and recommended behaviour for opening and closing access to resources is summarised in the following table.

	ByteIO Specification [6]	WSRF Rendering [7]
<b>RandomByteIO</b>		
Open (Create)	Out of scope	-
Close (Destroy)	In scope.  The resource should be terminated and an appropriate clean-up performed. Whether the resource itself should be destroyed or just the Web service used to access it is implementation dependent. It is a requirement that subsequent requests to the resource should fail with an error which indicates that the resource is no longer available. (Section 5.2)	Implementation of a ‘close’ or ‘destroy’ function is optional. However, any implementation must conform to the <i>OGSA WSRF Basic Profile</i> [14]. (Section 3)
<b>StreamableByteIO</b>		
Open (Create)	Out of scope  The following suggestions are made. Clients should be able to specify an ‘open’ mode and an ‘access’ mode.  The open mode options include: create, append, truncate, create-new, open and open-or-create. The last is particularly important to support legacy applications.  The access mode options include: read, write and read-and-write.  (Sections 5.1 and 2.4, paragraph 1)	-
Close (Destroy)	In scope.  It is a requirement that requests subsequent to termination of the resource should fail with an error which indicates that the resource is no longer available.  Termination should <i>never</i> destroy the underlying data resource or Web service, but merely terminate access to it. (Section 5.2)	The <i>OGSA WSRF Basic Profile</i> [14] requires that StreamableByteIO must support the ImmediateResourceTermination and ScheduledResourceTermination port types. These port types are defined in <i>Web Services Resource Lifetime</i> [18]. (Section 3)

A NextGRID data access service must comply with the *ByteIO Specification*:

**R0531** A *BYTEIOINSTANCE* MUST comply with the behaviour specified in the *ByteIO Specification [6]* and the *ByteIO OGSA WSRF Basic Profile Rendering [7]* for closing or destroying access to a resource.

**R0532** A *BYTEIOINSTANCE* SHOULD comply with the behaviour recommended in the *ByteIO Specification [6]* and the *ByteIO OGSA WSRF Basic Profile Rendering [7]* for opening or creating access to a resource.

## 5.4 Concurrency

The *ByteIO* specification provides simple POSIX-file-like data access. It does not address the question of simultaneous access by multiple clients performing a variety of read and write operations. Any management of the effects of such concurrent access must be performed by the data access service outwith *ByteIO*.

**R0541** A *BYTEIOINSTANCE* which wishes to manage concurrent access MUST perform such management itself; *ByteIO* will not do so.

## 5.5 *ByteIO* Properties

The *ByteIO Specification* [6] requires that a service offering *ByteIO* access must provide a number of properties. It also specifies additional properties that the service may provide. There are two sets of properties, one for the *RandomByteIO* port type and the other for the *StreamableByteIO* port type. Some of the properties in the two sets are the same, others differ. This Profile places additional restrictions on these properties, as follows.

- **Property TransferMechanism** (port types: *RandomByteIO* and *StreamableByteIO*). This mandatory property specifies the transfer mechanisms supported by the service. Its value is a list of URIs identifying the mechanisms available. Data transfer in NextGRID is performed according to the *NextGRID Data Transfer Profile* [5]. Thus, any transfer mechanisms included in the *TransferMechanism* list must be compatible with the *NextGRID Data Transfer Profile*. That is:

**R0551** The *TransferMechanism* properties of a *BYTEIOINSTANCE* MUST include only transfer mechanisms that are compatible with the *NextGRID Data Transfer Profile* [5].

- **Property DataResource** (port type: *StreamableByteIO*). The optional *ByteIO* property *DataResource* specifies an EPR for the resource, if one is available. In NextGRID data resources (and other entities) are represented by EPRs. Thus, for a NextGRID resource an EPR

must be available. Further, NextGRID EPRs are required to be WS-Addresses annotated with naming elements, as prescribed in the *NextGRID Naming Profile* [4] and references therein. Consequently:

**R0552** A *BYTEIOINSTANCE* supporting the *StreamableByteIO* port type **MUST** contain the *StreamableByteIO* property *DataResource*.

**R0553** The *StreamableByteIO* property *DataResource* of a *BYTEIOINSTANCE* supporting the *StreamableByteIO* port type **MUST** conform to the NextGRID Naming Profile [4].

## 6 OGSA WS-DAI Profile

This section of the Profile incorporates sections of the following specification by reference:

- *Web Services Data Access and Integration – The Core (WS-DAI) Specification* [8].

A NextGRID data storage service is equivalent to a WS-DAI Data Service with an Externally Managed Data Resource ([8], Figure 1, p7).

A WS-DAI Data Service may be represented as a WSRF data resource, but such a representation is optional ([8], Section 3.3, p6). However, NextGRID services are defined in terms of mappings to WSRF. Consequently:

**R0601** A *WSDAIINSTANCE* **MUST** conform to the WSRF representation of a WS-DAI service.

### 6.1 Naming

**Datasets** are named according to the *NextGRID Naming Profile* [4]. NextGRID naming is a specialisation of WS-Naming, which in turn uses WS-Addressing.

WS-DAI resources are addressed using WS-Addressing End Point References (EPR; [8], p9). Thus:

**R0611** EPRs for a WS-DAI resource corresponding to a *DATASET* **MAY** be further annotated with NextGRID naming elements, as described in the *NextGRID Naming Profile* [4].

Further, the *NextGRID Naming Profile* places restrictions on the use of WS-Naming and WS-Addressing elements. Consequently:

**R0612** *WS-Naming and WS-Addressing elements occurring in the EPRs for a WS-DAI resource corresponding to a DATASET MUST conform to the NextGRID Naming Profile [4].*

## 6.2 Data Representations and Query Languages

The WS-DAI specifications are independent of data representation. There are intended to be realisations for various types of data representation, of which two are currently available: WS-DAIR [19] for relational data and WS-DAIX [20] for XML. WS-DAI is similarly agnostic about query languages, with the assumption that SQL, XQuery or other query languages will be used as appropriate.

NextGRID places no additional restrictions on the use of data representations or query languages.

## 7 Data Transfer

Data transfer in NextGRID occurs in accordance with the *NextGRID Data Transfer Profile* [5]. Thus, a NextGRID data access service must:

- act as a source of data, within the context of the *Data Transfer Profile*, when a **dataset** is being read,
- act as a sink of data, within the context of the *Data Transfer Profile*, when a **dataset** is being written or updated.

Consequently:

**R0701** *When a **dataset** is being read from an INSTANCE the INSTANCE MUST act as a source of data within the context of the NextGRID Data Transfer Profile [5].*

**R0702** *When a **dataset** is being written to, or updated on, an INSTANCE the INSTANCE MUST act as a sink of data within the context of the NextGRID Data Transfer Profile [5].*

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