REST for CORBA

V1.0—beta 1

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Preface

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1 Scope

The REST for CORBA specification defines a standard and interoperable mechanism to enable CORBA objects to be exposed as REST services.

The REST for CORBA specification defines:
- a set of standard IDL annotations (IDL-RS) to decorate IDL constructs in order to expose the corresponding CORBA objects as REST services that can be consumed by REST client applications.
- Data Representation Formats to externalize objects defined with the IDL Type Representation format to JSON and XML Data Representation formats.
2 Conformance

This specification defines the following conformance points:

<table>
<thead>
<tr>
<th>Table 2.1: Conformance Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDL-RS</td>
</tr>
<tr>
<td>JSONDR</td>
</tr>
<tr>
<td>XMLDR</td>
</tr>
</tbody>
</table>

This specification defines the following compliance levels:

<table>
<thead>
<tr>
<th>Table 2.2: Compliance Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDL-RS</td>
</tr>
<tr>
<td>IDL-RS + JSONDR</td>
</tr>
<tr>
<td>IDL-RS + XMLDR</td>
</tr>
<tr>
<td>IDL-RS + JSONDR + XMLDR</td>
</tr>
</tbody>
</table>
3 Normative References

The following normative documents contain provisions which, through reference in this text, constitute provisions of this specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply.

[IDL] Object Management Group, Interface Definition Language, Version 4.2 (https://www.omg.org/spec/IDL/4.2) – IDL is a descriptive language used to define data types and interfaces in a way that is independent of the programming language or operating system/processor platform.


[C2WSDL] Object Management Group, CORBA to WSDL/SOAP Interworking Specification, Version 1.2.1 (https://www.omg.org/spec/C2WSDL), formal/08-08-03 – Defines a mapping from IDL to XmlSchema and provides a natural mapping from IDL to WSDL that is also suitable for a reverse mapping, from the mapped subset of WSDL back to IDL.

[CORBABINDING] Object Management Group, CORBA Binding for WSDL, Version 1.0 (https://www.omg.org/spec/CORBABINDING), formal/2010 05 08 – Defines a WSDL extension called a “CORBA type map.” The type map specifies CORBA type definitions that are used within CORBA bindings to accurately specify constants, parameter types, return types, and exception types.


[HTML] W3C HTML 4.01 Specification: https://www.w3.org/TR/html4


4 Terms and Definitions

For the purposes of this specification, the following terms and definitions apply.

**Camel Case**

A naming convention that represents phrases composed of multiple word using a single word where spaces and punctuation are removed, and every word begins with a capital letter. In this specification, the term Camel Case refers to the variation of Camel Case commonly-known as Lower Camel Case, where the first letter is not capitalized. For example, the Camel Case representation of “these are my words” would be “theseAreMyWords”.

**Pascal Case**

Also known as Upper Camel Case, is a variation of Camel Case where the first letter is capitalized. For example, the Pascal Case representation of the phrase “these are my words” would be “TheseAreMyWords”.
5  Symbols

The acronyms used in this specification are show in Table 5.1.

Table 5.1: Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSONDR</td>
<td>JSON Data Representation format, defined in section 9</td>
</tr>
<tr>
<td>XMLDR</td>
<td>XML Data Representation format, defined in section 10</td>
</tr>
</tbody>
</table>
6      Additional Information

6.1    Changes to Adopted OMG Specifications

This specification does not change any adopted OMG specification.

6.2    Acknowledgments

The following companies submitted this specification:
• Micro Focus
7 REST for CORBA overview

The goal of the REST for CORBA specification is to define a standard and interoperable mechanism to enable CORBA objects to be exposed as REST [REST] services and to enable pure REST clients to transparently use CORBA services through the exposed REST façade.

In order to achieve the above goals, this submission defines:

- a set of standard IDL annotations (IDL-RS) to decorate IDL constructs in order to expose the corresponding CORBA objects as REST services that can be consumed by REST client applications.
- a set of standard IDL annotations (IDL-RS) to decorate IDL constructs in order to expose the corresponding CORBA objects as REST services that can be consumed by REST client applications.

7.1 IDL-RS annotations overview

The IDL-RS annotations provide a standard mechanism to decorate IDL constructs with IDL annotations to clearly and unambiguously define REST representations of CORBA services. The IDL-RS annotations strive to comply with the Representational State Transfer (REST) architectural style. The design of the IDL-RS annotations assume that HTTP is the underlying network transport layer protocol and aim to provide a clear mapping between HTTP resources and the corresponding CORBA objects.

IDL-RS annotations are described in section 8.

7.2 Data representation formats overview

A Data Representation format defines the way in which objects of the types defined by the IDL Type System may be externalized such that they can be stored in a file or communicated over a network (this is also commonly referred as “data serialization” or “data marshaling”). The JSON and XML Data Representation formats are typically used in REST applications and provide an alternative to the encoding mechanism to the standard Common Data Representation (CDR) format used in CORBA applications.

The Data Representation Formats to externalize objects defined with the IDL Type Representation format to JSON and XML Data Representation formats are described in section 9 and section 10 respectively.
8 IDL-RS annotations

The IDL-RS annotations are a set of standard IDL annotations. They provide a standard mechanism to decorate IDL constructs with IDL annotations to clearly and unambiguously define REST representations of CORBA services.

IDL-RS annotations are designed to comply with the Representational State Transfer [REST] architectural style and assume that HTTP is the underlying network transport layer protocol.

The standard IDL-RS annotations are defined in the IDL module IDL_RS as specified below.

8.1 Assigning REST Uniform Resource Identifiers to IDL constructs

CORBA objects are exposed as REST resources [REST] using the @Path annotation. The @Path annotation assigns a mapping between HTTP resources and the corresponding CORBA objects.

The @Path annotation binds the specified URI [URI] or URI templates [URI-TEMPLATE] to the IDL construct that it is is applied to.

8.1.1 @Path annotation

The @Path annotation is defined as:

```idl
module IDL_RS {
  @annotation Path {
    string uri;
    string rir default "";
  };
};
```

The uri parameter specifies the Uniform Resource Identifier to bind to. The accepted values are strings representing a valid URI path or a valid URI path template. The effective URI assigned to the annotated IDL construct is obtained as follows:

- if IDL constructs in the enclosing scopes are not annotated with @Path annotations, then the effective URI is defined by the value of the uri parameter.
- if IDL constructs in the enclosing scopes are annotated with @Path annotations, then the effective URI is defined by the concatenation of the URI assigned to the enclosing scopes with the URI assigned to the uri parameter.

The rir parameter allows binding the URI specified in the uri parameter to the initial reference specified in the rir parameter. A typical usage pattern of the rir parameter is to bind a persistent CORBA object reference to its URI. The rir parameter is optional. When the rir parameter is not specified, the default value of empty string is implied and no object reference is explicitly bound to the uri parameter.

8.1.1.1 @Path Applicability

The @Path annotation is applicable to:

- IDL module
- IDL interface
- IDL operation
- IDL attribute
8.1.1.2 URI path example

```java
import IDL_RS;

@Path("/service")
module Mod {

    interface Int {

        typedef sequence<octet> OctetSeq;

        @Path("send-data")
        void op(in OctetSeq bytes);
    };
};
```

The URI to represent the IDL operation: ::Mod::Int::send_bytes() would be a concatenation of all the @Path annotations as we walk the IDL tree from our current enclosing scope all the way to the root scope of IDL tree. Each @Path annotations uri parameter would be concatenated together, using a forward slash “/” as a separator, if the current URI does not already end in a forward slash. In the example above this would generate the URI: /service/send-data.

8.1.2 @PathParam annotation

The @PathParam annotation specifies a binding between the matching URI path template parameter and the IDL parameter it is applied to.

The matching URI path template parameter is defined as the URI path template parameter that:
• has the same name as the string specified in the path_param_id annotation parameter
• is contained in a URI path template (as specified by the @Path annotation) bound to an enclosing IDL naming scope.

The @PathParam annotation is defined as:

```java
module IDL_RS {
    @annotation PathParam {
        string path_param_id;
    };
};
```

The path_param_id parameter specifies the name of the matching URI path template parameter.

The @PathParam annotation is applicable to:
• IDL operation parameters of basic types as defined in IDL 4.2, Section 7.4.1.4.2, Basic Types.

8.1.2.1 URI path template example

```java
import IDL_RS;

interface Account{

interface Bank {
```
@Path("/bank/account/{id}")
Account create_account(@PathParam("id") in long account_id);
);

In the above example the URI template {id} is replaced by the value of IDL parameter account_id, to generate a unique URI that corresponds to our CORBA object. The @PathParam annotation is used to bind a URI template to an individual IDL parameter. Possible values for our URI may be:/bank/account/1, /bank/account/2, and so on.

8.1.3 @QueryParam annotation

The @QueryParam annotation specifies a binding between a matching URI query parameter contained in the request target URI field of the HTTP request message and the IDL parameter it is applied to.

URI query parameters are contained within a URI query string. A URI query string (as defined in [URI] and [URI-TEMPLATE]) is a string that is appended to a URI path and that begins with the character “?” . It is composed of one or more URI query parameters. A URI query parameter is a string representation of a key-value pair. The query parameter string is composed of the key, followed by the “=” character, followed by the value. Multiple URI query parameters are separated by the “&” character.

A matching URI query parameter is defined as the URI query parameter that has the same key as the string specified in the query_param_id annotation parameter.

The @QueryParam annotation is defined as:

module IDL_RS {
   @annotation QueryParam {
      string query_param_id;
   };
};

The query_param_id annotation parameter specifies the URI query parameter key. The value extracted from the matching URI query parameter is injected into the IDL operation parameter that the @QueryParam annotation is applied to.

The @QueryParam annotation is applicable to:
- IDL operation parameters of basic types as defined in IDL 4.2, Basic Types, Section 7.4.1.4.2.

8.1.3.1 @QueryParam Example

import IDL_RS;

interface Account{
   @Path("withdraw")
   void withdraw_funds(@QueryParam("account-id") in long account_id,
                        @QueryParam("amount") in float funds);
};

In the above example, the URI /withdraw is bound to the IDL operation ::Account::withdraw_funds() by the @Path annotation. The @QueryParam annotations attached to the IDL operation parameters account_id and funds, of type long and float respectively, specify that an HTTP request to the /withdraw?account_id=500&amount=100.00 target URI will result in the extraction of the (account_id, 500) and (amount, 100.00) key-value pairs and the injection of the value 500 into the long account_id parameter and 100.00 into the float funds parameter.
8.1.4  Obtaining string representations of IDL object references

The `{objkey}` URI template parameter has special semantics, different from what is defined in @Path annotation, section 8.1.1, when:

- the URI template containing `{objkey}` is used in an @Path annotation applied to an IDL interface; and
- this annotated IDL interface is used as an object reference in the IDL; i.e. being used as an IDL operation parameter type or return type.

In this case, the value of the `{objkey}` URI template parameter will be assigned an arbitrary string that uniquely identifies the specific CORBA Object instance that the object reference refers to. Compliant implementations must provide this unique identifier and inject its value into the `{objkey}` URI template parameter.

Compliant implementations may compute the value of the `{objkey}` URI template parameter by retrieving the object key for the specific CORBA Object instance (defined in IDL as a `sequence<octet>` type) and converting it to a string representation by Base64 encoding it.

8.1.4.1  `{objkey}` URI path template parameter example

```java
import IDL_RS;

@Path("account/{objkey}")
interface Account { /* … */};

interface Bank {
   @PUT
   @Path("/bank/account/{id}")
   Account create_account(@PathParam("id") in long account_id);
};
```

In the above excerpt, the use of `{objkey}` in @Path annotation applied to the Account interface meets the conditions defined in section 8.1.4. The Account interface is used as an object reference in the return parameter of the `create_account()` operation. The URI anchored to an instance of the `Account` object reference return parameter, as specified by the @Path annotation to the `Account` interface, will appear as `/account/4YYASBSDFJ3456JSDF==`, where the `4YYASBSDFJ3456JSDF==` string is the unique string representation of a specific CORBA `Object` instance of type `Account`.

8.2  Assigning Request Method Designators to IDL constructs

The @GET, @PUT, @POST, @DELETE annotations designate the HTTP request methods that are associated with the IDL constructs they are applied to.

The @GET, @POST, @PUT, @DELETE annotations are applicable to:

- IDL operation

A resource IDL operation is an IDL operation:

- anchored to a URI or URI template path as assigned by an @Path annotation in an enclosing IDL naming scope.
- anchored to an HTTP method designator as assigned by one of @GET, @POST, @PUT, @DELETE annotations.

A resource IDL attribute is an IDL attribute:
• anchored to a URI or URI template path as assigned by an @Path annotation in an enclosing IDL naming scope.
• anchored to an HTTP method designator as assigned by one of @GET, @POST, @PUT, @DELETE annotations.

8.2.1  @GET annotation
The @GET annotation specifies that the annotated IDL operation or attribute is capable of receiving a HTTP GET requests from a REST client.

The @GET annotation specifies that HTTP request messages can be dispatched to the annotated resource IDL operation or annotated resource IDL attribute if:

• the target URI of the HTTP request message matches the URI anchored to the IDL operation or attribute
• the HTTP method specified in the HTTP request method is GET

When @GET is applied to an IDL attribute, it binds to the attribute accessor function that retrieves the value of the attribute.

The IDL definition for this annotation is:

module IDL_RS {
  @annotation GET {};
};

8.2.1.1  @GET example
import IDL_RS;
@Path("/account/{objkey}")
interface Account {

  @GET
  float get_balance();
};

The @Path annotation applied to the Account interface binds the specific Account object instance to URI path template /account/{objkey}, where the {objkey} URI template parameter will be injected with a unique identifier of the CORBA object, as defined in section 8.1.4.

The @GET annotation applied to IDL operation get_balance() binds it to HTTP GET requests targeting URI /account/{objkey}. HTTP GET requests targeting a URI such as: /account/4YYASBSDFJ3456JSDF== will be dispatched to the IDL operation get_balance().

8.2.2  @POST annotation
The @POST annotation specifies that the annotated IDL operation or attribute is capable of receiving a HTTP POST requests from a REST client.

The @POST annotation specifies that HTTP request messages can be dispatched to the annotated resource IDL operation or annotated resource IDL attribute if:

• the target URI of the HTTP request message matches the URI anchored to the IDL operation or attribute
• the HTTP method specified in the HTTP request method is POST
When `@POST` is applied to an IDL attribute, it binds to the attribute accessor function that sets the value of the attribute.

The IDL definition for this annotation is:

```idl
module IDL_RS {
    @annotation POST {};
);
```

### 8.2.2.1 @POST example

```idl
import IDL_RS;

@Path("/account/{objkey}")
interface Account {

    @POST
    void deposit(@QueryParam("amount") in float funds);
};
```

The `@Path` annotation applied to the `Account` interface binds the specific `Account` object instance to URI path template `/account/{objkey}`, where the `{objkey}` URI template parameter will be injected with a unique identifier of the CORBA object, as defined in section 8.1.4.

The `@POST` annotation applied to IDL operation `deposit()` binds it to HTTP POST requests targeting URI `/account/{objkey}`. HTTP POST requests targeting a URI such as: `/account/4YYASBSDFJ3456JSDF==` will be dispatched to the IDL operation `deposit()`.

The `@QueryParam` annotation applied to the `funds` parameter of operation `deposit()` specifies that the operation binds to a URI containing a query parameter, such as `/account/4YYASBSDFJ3456JSDF==?amount=1000.45` (as defined in section 8.1.3). The `amount` query parameter is parsed and its value is extracted and injected into the `funds` parameter of the `deposit()` operation.

### 8.2.3 @PUT annotation

The `@PUT` annotation specifies that the annotated IDL operation or attribute is capable of receiving a HTTP PUT requests from a REST client.

The `@PUT` annotation specifies that HTTP request messages can be dispatched to the annotated resource IDL operation or annotated resource IDL attribute if:

- the target URI of the HTTP request message matches the URI anchored to the IDL operation or attribute
- the HTTP method specified in the HTTP request method is PUT

When `@PUT` is applied to an IDL attribute, it binds to the attribute accessor function that sets the value of the attribute.

The IDL definition for this annotation is:

```idl
module IDL_RS {
    @annotation PUT {};
);
```

### 8.2.3.1 @PUT example

```idl
import IDL_RS;
```
@Path("/account/{objkey}""
interface Account { /* ... */

interface Bank {
    @Path("/bank/account/{account-id}""
    @PUT
    Account find_account(@PathParam("account-id") in long account_id);
    
    The @Path annotation applied to the find_account() operation binds it to the /bank/account/{account-id} URI.
    The @PathParam annotation applied to the account_id parameter of operation find_account() specifies that the URI
    path template parameter {account-id} will be parsed and its value extracted and injected into the account_id IDL
    parameter of operation find_account() (as defined in section 8.1.2).
    The @PUT annotation applied to IDL operation create_account() binds it to HTTP PUT requests targeting URI
    /account/{objkey}. HTTP PUT requests targeting a URI such as: /bank/account/1337 will be dispatched to the IDL
    operation find_account() and the value 1337 will be injected into parameter account_id.
    
    The return result of operation find_account() is an Account object instance. The @Path annotation applied to the
    Account interface binds the specific Account object instance to URI path template /account/{objkey}, where the
    {objkey} URI template parameter will be injected with a unique identifier of the CORBA object, as defined in section
    8.1.4, such as: /account/4YYASBSDFJ3456JSDF==

8.2.4  @DELETE annotation
The @DELETE annotation specifies that the annotated IDL operation or attribute is capable of receiving a HTTP
DELETE requests from a REST client.
    The @DELETE annotation specifies that HTTP request messages can be dispatched to the annotated resource IDL
    operation or annotated resource IDL attribute if:
    • the target URI of the HTTP request message matches the URI anchored to the IDL operation or attribute
    • the HTTP method specified in the HTTP request method is DELETE

The IDL definition for this annotation is:

module IDL_RS {
    @annotation DELETE {};
}

8.2.4.1  @DELETE example

import IDL_RS;

@Path("/account/{objkey}""
interface Account {

    @DELETE
    void delete_account();
}

The @Path annotation applied to the Account interface binds the specific Account object instance to URI path template
/account/{objkey}, where the {objkey} URI template parameter will be injected with a unique identifier of the CORBA object, as defined in section 8.1.4.
The @DELETE annotation applied to IDL operation delete_account() binds it to HTTP DELETE requests targeting URI /account/{objkey}. HTTP DELETE requests targeting a URI such as: /account/4YYASBSDFJ3456JSDF== will be dispatched to the IDL operation delete_account().

8.3 Controlling Data Representation format encoding

The @Consumes and @Produces annotations specify the Data Representation format that the annotated resource IDL constructs use to produce data representations. This specification defines two standard Data Representation formats:

- JSON Data Representation format, defined in section 9, page 19
- XML Data Representation format, defined in section 10, page 32

The Data Representation formats used are mapped to HTTP request and response media types [HTTP] and are specified in HTTP request and response messages using the standard HTTP Content-Type and Accept headers.

8.3.1 @Consumes Annotation

The @Consumes annotation defines that the annotated IDL construct can consume messages containing data in the Data Representation format specified by media_type annotation parameter. The media_type annotation parameter shall contain a string representing an HTTP media type or a comma-separated list of HTTP media types.

The @Consumes annotation is defined as:

```
module IDL_RS {
    @annotation Consumes {
        string media_type;
    };
}
```

8.3.2 @Produces Annotation

The @Produces annotation defines that the annotated IDL construct can produce messages containing data in the Data Representation format specified by media_type annotation parameter. The media_type annotation parameter shall contain a string representing an HTTP media type or a comma-separated list of HTTP media types.

The @Produces annotation is defined as:

```
module IDL_RS {
    @annotation Produces {
        string media_type;
    };
}
```

8.3.3 @Produces and @Consumes Example

Both the above annotations take a string argument that describes the data format as a media type string. For JSON this is: application/json, and for XML this is: application/xml.

The following IDL excerpt shows an example of @Consumes and @Produces usage:

```
import IDL_RS;

@Path("/name")
@Consumes("application/xml")
@Produces("application/json")
void greet_me(in string name, out string greeting);
```
The IDL `greet_me()` operation is a resource IDL operation anchored to the `/name` URI. The `@Consumes` annotation declares that HTTP messages directed to the `/name` target URI and containing data in XML Data Representation format can be dispatched to the `greet_me()` IDL operation. The `@Produces` annotation declares that data returned by the `greet_me()` IDL operation shall be represented in JSON Data Representation format.

IDL types that are applicable to the other IDL-RS annotations. For a list see the applicability section: “@Path Applicability”.

### 8.3.4 @Consumes and @Produces Applicability

The `@Consumes` and `@Produces` annotations are applicable to:  
- IDL module  
- IDL interface  
- IDL operation  
- IDL attribute

`@Produces` and `@Consumes` annotations are inherited from enclosing IDL scopes.

### 8.4 Assigning HTTP status code representations to IDL exceptions

In CORBA, an IDL operation can raise an exception to indicate that an operation request was not performed successfully. An exception may be accompanied by additional, exception-specific information, as defined in the IDL exception declaration.

In REST, HTTP responses start with a status line, containing the following information:

- The protocol version, such as HTTP/1.1.  
- A status code, such as 200 or 404.  
- A status text – a brief, informational, textual description of the status code.

A typical status line might look like: HTTP/1.1 404 Not Found.

HTTP response status codes indicate whether a specific HTTP request has been successfully completed. Responses are grouped in five classes: informational responses (100–199), successful responses (200–299), redirects (300–399), client errors (400–499), and server errors (500–599).

#### 8.4.1 @HTTPStatus Annotation

The `@HTTPStatus` annotation defines a mapping between a CORBA IDL exception it is applied to and an HTTP status code and status text description. The `code` annotation parameter specifies the HTTP response status code. The optional `description` parameter specifies the HTTP response status text.

The `@HTTPStatus` annotation is defined as:

```idl
module IDL_RS {
    @annotation HTTPStatus {
        long code;
        string description default "";
    };
}
```

#### 8.4.1.1 @HTTPStatus applicability

The `@HTTPStatus` annotation is applicable to:
• IDL exception

8.4.1.2  @HTTPStatus annotation example

```java
import IDL_RS;

@Path("/account/{objkey}")
interface Account {

    @HTTPStatus{
        code = 409, description = "Insufficient Funds Available"
    }
    exception InsufficientFunds {
        string reason;
    }

    @POST
    @Path("withdraw")
    void withdraw(in float funds) raises InsufficientFunds;
}
```

The @HTTPStatus annotation applied to the IDL exception InsufficientFunds maps it an HTTP status code of 409 and status text of Insufficient Funds Available.

The @Path annotation applied to the Account interface binds the specific Account object instance to URI path template /account/{objkey}, where the {objkey} URI template parameter will be injected with a unique identifier of the CORBA object, as defined in section 8.1.4.

The @POST annotation applied to IDL operation withdraw() binds it to HTTP POST requests targeting URI /account/{objkey}/withdraw. HTTP POST requests targeting a URI such as: /account/4YYSBSDFJ3456JSDF==/withdraw will be dispatched to the IDL operation withdraw(). When an IDL exception InsufficientFunds is raised, the HTTP response message status line will be set to HTTP/1.1 409 Insufficient Funds available.

8.4.2  Mapping CORBA System Exceptions to HTTP Status Codes (Non-normative)

CORBA Standard System Exception can be raised even though they are not declared in a raises clause in the IDL.

This section outlines a mapping between CORBA Standard System Exceptions and HTTP status codes that a compliant implementation may follow.

<table>
<thead>
<tr>
<th>CORBA System Exception</th>
<th>HTTP Response Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMM_FAILURE</td>
<td>TIMEOUT (408)</td>
</tr>
<tr>
<td>TIMEOUT</td>
<td></td>
</tr>
<tr>
<td>OBJECT_NOT_EXIST</td>
<td>GONE (410)</td>
</tr>
<tr>
<td>INV_OBJREF</td>
<td></td>
</tr>
<tr>
<td>TRANSIENT</td>
<td>NOT_FOUND (404)</td>
</tr>
</tbody>
</table>

REST for CORBA, 1.0
<table>
<thead>
<tr>
<th>Exception</th>
<th>Status Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO_PERMISSION</td>
<td>FORBIDDEN (403)</td>
</tr>
<tr>
<td>BAD_OPERATION</td>
<td>METHOD_NOT_ALLOWED (405)</td>
</tr>
<tr>
<td>BAD_PARAM</td>
<td></td>
</tr>
<tr>
<td>MARSHAL</td>
<td>BAD_REQUEST (400)</td>
</tr>
<tr>
<td>INTERNAL</td>
<td>INTERNAL_SERVER_ERROR (500)</td>
</tr>
<tr>
<td>INITIALIZE</td>
<td></td>
</tr>
<tr>
<td>NO_IMPLEMENT</td>
<td>NOT_IMPLEMENTED (501)</td>
</tr>
<tr>
<td>IMP_LIMIT</td>
<td>SERVICE_UNAVAILABLE (503)</td>
</tr>
<tr>
<td>NO_MEMORY</td>
<td></td>
</tr>
<tr>
<td>NO_RESOURCES</td>
<td></td>
</tr>
<tr>
<td>All other System Exceptions</td>
<td>CONFLICT (409)</td>
</tr>
</tbody>
</table>
9 JSON Data Representation format

This section specifies a mapping between IDL types and JSON [JSON] Data Representation (JSONDR) syntax. For the IDL types defined below, a mapping is defined to convert the data from the CORBA Common Data Representation format to JSON Data Representation format and vice-versa (i.e. from CDR to JSONDR and JSONDR to CDR).

9.1 IDL Core Data Types

9.1.1 Basic types

9.1.1.1 Integer types

The value of an instance of an IDL integer data types: short, unsigned short, long, unsigned long, long long, and unsigned long long are represented as a JSON integer number type, as defined in IDL 4.2, section 7.2.6.1, Integer Literals.

For example, an instance of an IDL long type containing the value 123:

```c
long return_code;
```

shall be represented in JSON as:

```json
123
```

9.1.1.2 Floating point types

The value of an instance of an IDL floating-point types: float, double, and long double are represented as a JSON number type, as defined in IDL 4.2, section 7.2.6.2, Floating-point Literals.

For example, an instance of an IDL float type containing the value -1.1225E8:

```c
float float_val;
```

shall be represented in JSON as:

```json
-1.1225E8
```

9.1.1.3 Character types

The value of an instance of an IDL character data types: char and wchar are represented as JSON string type containing a single character, and the character shall be encoded as defined in IDL 4.2, section 7.2.6.2 Character Literals.

For example an instance of an IDL char type containing the value ‘x’:

```c
char char_val;
```

shall be represented in JSON as:
9.1.4 Boolean type

The value of an instance of the IDL boolean data type shall be represented as either JSON true value or JSON false value.

For example, an instance of the following IDL boolean containing the value FALSE:

```c
boolean bool_val;
```

shall be represented in XML as:

```xml
false
```

9.1.5 Octet type

The value of an instance of the IDL octet data type shall be represented as a JSON integer number value, and following the bounds rules for an IDL octet data type as defined in IDL 4.2, Section 7.4.1.4.3, Constants.

For example, an instance of the following IDL octet containing the value 254:

```c
octet octet_val;
```

shall be represented in JSON as:

```json
254
```

9.1.2 Template types

9.1.2.1 Sequence types

The value of an instance of the IDL sequence data type shall be represented as a JSON array that, for each element in the IDL sequence, contains a JSON array element set to the JSON representation of the value of the IDL sequence element, as specified in section 9.

For example, an instance of the following IDL sequence containing octet value 2, 3, 5:

```c
typedef sequence<octet> octetSeq;
```

shall be represented in JSON as:

```json
[2, 3, 5]
```

9.1.2.2 String types

The value of an instance of the IDL string and wstring data types shall be represented as a JSON string set to the value of the IDL string or wstring instance, as defined in IDL 4.2, section 7.2.6.3 String Literals.
For example, an instance of the following IDL string containing “my example string”:

```idl
typedef string my_string;
```

shall be represented in JSON as:

```
my example string
```

### 9.1.2.3 Fixed point types

The value of an instance of the IDL `fixed` data type shall be represented as a JSON fraction number set to the representation of the value as defined in IDL 4.2, section 7.2.6.5 Fixed-Point Literals (the “d” or “D” character may be omitted).

For example, an instance of the following IDL fixed type containing the value 123.45d with digits 5 and scale 2:

```idl
typedef fixed<5, 2> my_fixed;
```

shall be represented in JSON as:

```
123.45
```

### 9.1.3 Constructed types

#### 9.1.3.1 Struct types

The value of an IDL struct data type instance shall be represented as a JSON object. Each IDL struct member shall be represented as a JSON object member, where the JSON object member name is set to the IDL struct member identifier, and the JSON object member value is set to the representation of the IDL struct member value as defined for its type in section 9.

For example, an instance of the following IDL struct type, with `string_val` member set to “Joe Bloggs”, `char_val` member set to “c”, `octet_val` set to 200, `short_val` set to 10000, `long_val` set to -2323424, `ulonglong_val` set to 3424234243:

```idl
struct StructType {
    string string_val;
    char char_val;
    octet octet_val;
    short short_val;
    long long_val;
    unsigned long long ulonglong_val;
};
```

shall be represented in JSON as:

```
{
    "string_val": "Joe Bloggs",
    "char_val": "c",
    "octet_val": 200,
    "short_val": 10000,
    "long_val": -2323424,
    "ulonglong_val": 3424234243
}
```
9.1.3.2  Enum types

The value of an instance of the IDL enum data type shall be represented as a JSON string value set to the enums current enumerator identifier value.

For example, an instance of the following IDL enum with value set to RED:

```cpp
enum Color {RED, GREEN, BLUE};
```

shall be represented in JSON as:

```
"RED"
```

9.1.3.3  Union types

The value of an instance of an IDL union data type shall be represented as a JSON object containing:

- an object member, where the object member name is set to discriminator and the JSON object member value is set to either:
  - the JSON representation, as defined in section 9, of the value of the case label of the IDL union discriminator type, if the value of the case label matches one of the cases of the union,
  - _default, if the default case of the union is selected.
- an object member, where the object member name is set to value and the JSON object member value is set to the JSON representation, as defined in section 9, of the value of the IDL union case type selected by the discriminator.

For example, an instance of the following IDL union with discriminator set to LEFT and value set to 10.5:

```cpp
enum Direction {UP, DOWN, LEFT, RIGHT, NONE, UNKNOWN};
union Movement switch(Direction) {
  case UP:
  case DOWN:
  case LEFT:
  case RIGHT:
    float distance;
  case NONE:
    long time_still;
  default:
    short error_code;
};
```

shall be represented in JSON as:

```
{
  "discriminator": "LEFT",
  "value": 10.5
}
```
An instance of the previous Movement IDL union with discriminator set to UNKNOWN and value set to 255 shall be represented in JSON as:

```json
{
    "discriminator": "_default",
    "value": 255
}
```

9.1.3.4 Array types
The value of an instance of an IDL array data type shall be represented in JSON according to the same rules as specified for IDL sequence types, as defined in section 9.1.2.1.

9.1.3.5 Native types
A native type may be used only to define IDL operation parameters and results. Native type parameters are permitted only in operations of local interfaces or valuetypes. Native types cannot be used as operation parameters or results in remote invocations. As such, no JSON data representation mapping of native types is specified.

9.2 IDL Any type
An IDL any instance shall be represented as a JSON object containing:

- an object member, where the object member name is set to `typecode` and the JSON object member value is set to the JSON representation of the `TypeCode`, as defined in section 9.2.1

9.2.1 TypeCode
In CORBA Common Data Representation (CDR) transfer syntax (the format in which the GIOP represents OMG IDL data types in an octet stream), `TypeCodes` are encoded as the `TCKind` enum value, followed by zero or more `TypeCode` parameter values. The encodings of the parameter lists fall into three general categories:

- TypeCodes with an empty parameter list
- TypeCodes with simple parameter lists
- TypeCodes with complex parameter lists

Table 9.2 in section 9.3.5.1.2, TypeCode Parameter Notation, of the CORBA Specification, 3.3, part 2, defines the type (i.e. empty, simple, complex parameter list) for each TypeCode TCKind enum value in the Type column and defines the ordered list of TypeCode parameters in the Parameters column.

The JSON representation of an instance of a `TypeCode` is correspondingly dependent on the TypeCode parameter list encoding rules defined by the CORBA specification, as defined in the following subsections.

9.2.1.1 Empty parameter list `TypeCode`
An empty `TypeCode` instance shall be represented as a JSON object containing an object member, where the object member name is set to `kind` and the JSON object member value is set to the JSON representation of the `TypeCode`'s `TCKind` enum value as defined in section 9.1.3.2

9.2.1.1.1 Empty parameter list `TypeCode` example
A TypeCode with a TCKind of tk_long describing an IDL long type such as:

```c
typedef long my_long;
```

shall be represented in JSON as:

```json
{
    "kind": "tk_long"
}
```

### 9.2.1.2 Simple parameter list TypeCode

A simple parameter list TypeCode is a TypeCode with a TCKind enum value set to either tk_string, tk_wstring, or tk_fixed.

#### 9.2.1.2.1 TypeCodes with TCKind set to tk_string or tk_wstring

A simple parameter list TypeCode instance with TCKind equal to either tk_string or tk_wstring shall be represented as a JSON object containing:

- an object member, where the object member name is set to kind and the JSON object member value is set to the JSON representation of the TypeCode’s TCKind enum value as defined in section 9.1.3.2
- an object member, where the object member name is set to bound and the JSON object member value is set to the JSON representation of the IDL unsigned long parameter defining the bound of the IDL string or wstring, as defined in section 9.1.1.1.

**Simple parameter list TypeCode with TCKind set to tk_string or tk_wstring examples**

A TypeCode with a TCKind of tk_string describing a bounded IDL string type such as:

```c
typedef string<80> bounded_string;
```

shall be represented in JSON as:

```json
{
    "kind": "tk_string",
    "bound": 80
}
```

#### 9.2.1.2.2 TypeCodes with TCKind set to tk_fixed

A simple parameter list TypeCode instance with TCKind equal to tk_fixed shall be represented as a JSON object containing:

- an object member, where the object member name is set to kind and the JSON object member value is set to the JSON representation of the TypeCode’s TCKind enum value as defined in section 9.1.1.1.
- an object member, where the object member name is set to digits and the JSON object member value is set to the JSON representation of the IDL unsigned short parameter defining the digits of the IDL fixed type, as defined in section 9.1.1.1.
- an object member, where the object member name is set to scale and the JSON object member value is set to the JSON representation of the IDL short parameter defining the scale of the IDL fixed type, as defined in section 9.1.1.1.
Simple parameter list TypeCode with TCKind set to tk_fixed examples

A TypeCode with TCKind of tk_fixed describing an IDL fixed type such as:

typedef fixed<5, 2> my_fixed;

shall be represented in JSON as:

```
{
    "kind": "tk_fixed",
    "digits": 5,
    "scale": 2
}
```

9.2.1.3 Complex parameter list TypeCode

9.2.1.3.1 TypeCodes with TCKind tk_sequence or tk_array

An complex parameter list TypeCode instance with TCKind equal to tk_sequence or tk_array shall be represented in JSON as an object containing:

- an object member, where the object member name is set to kind and the JSON object member value is set to the JSON representation of the TypeCode's TCKind enum value as defined in section 9.1.3.2
- an object member, where the object member name is set to element_typecode and the JSON object member value is set to the JSON representation of the TypeCode describing the type of the elements contained within the IDL sequence or array, as defined in section 9.2.1.
- an object member, where the object member name is set to length and the JSON object member value is set to the JSON representation, as defined in section 9.1.1.1, of the IDL unsigned long parameter defining the length the IDL array or the maximum length of the IDL sequence. The value of the length object member element shall be set to 0 for TypeCodes representing an unbounded IDL sequence.

Complex parameter list TypeCode with TCKind tk_sequence or tk_array examples

A TypeCode with a TCKind of tk_sequence describing an unbounded IDL sequence type such as:

typedef sequence<long> LongSeq;

shall be represented in JSON as:

```
{
    "kind": "tk_sequence",
    "element_typecode": {
        "kind": "tk_long"
    },
    "bound": 0
}
```
9.2.1.3.2 TypeCodes with TCKind other than tk_sequence or tk_array

A complex parameter list TypeCode instance with TCKind other than tk_sequence or tk_array shall be represented as a JSON object containing:

- an object member, where the object member name is set to kind and the JSON object member value is set to the JSON representation of the TypeCode’s TCKind enum value as defined in section 9.1.3.2
- an object member, where the object member name is set to id and the JSON object member value is set to the JSON representation of the CORBA::RepositoryId value returned by the TypeCode:id() operation, for TypeCode instances that allow the id() operation to be invoked, as defined in the CORBA specification 3.3, part 1, section 8.11.1.
- an object member, where the object member name is set to name and the JSON object member value is set to the JSON representation of the CORBA::Identifier value returned by the TypeCode:name() operation, for TypeCode instances that allow the name() operation to be invoked, as defined in the CORBA specification 3.3, part 1, section 8.11.1.

Complex parameter list TypeCode with TCKind other than tk_sequence or tk_array examples

A TypeCode with a TCKind of tk_struct describing an IDL struct type such as the following IDL struct named Example:

```idl
struct Example {
   short member1;
   short member2;
   long member3;
};
```

shall be represented in JSON as:

```json
{
   "kind": "tk_struct",
   "id": "IDL:Example:1.0",
   "name": "Example"
}
```

9.2.2 Any examples

9.2.2.1 Empty parameter list Any examples

An instance of an IDL any, which has had an instance of an IDL long type with a value of 10 inserted into it:

```idl
typedef long my_long;
typedef any my_any;
```

shall be represented in JSON as:

```json
{
   "typecode": {
      "kind": "tk_long"
   },
   "value": 10
}
```
9.2.2.2 Simple parameter list

Any examples

An instance of an IDL any, which has had an instance of an IDL bounded string type with a bound of 80 and a value of “example string” inserted into it:

typedef string<80> bounded_string;
typedef any my_any;

shall be represented in JSON as:

```
{
   "typecode": {
      "kind": "tk_string",
      "bound": 80
   },
   "value": "example_string"
}
```

An instance of an IDL any, which has had an instance of an IDL fixed type, with parameters digits equal to 5 and scale equal to 2 and a value of 123.45, inserted into it:

typedef fixed<5, 2> my_fixed;
typedef any my_any;

shall be represented in JSON as:

```
{
   "typecode": {
      "kind": "tk_fixed",
      "digits": 5,
      "scale": 2
   },
   "value": 123.45
}
```

9.2.2.3 Complex parameter list

Any examples

An instance of an IDL any, which has had an instance of an IDL unbounded sequence type inserted into it:

typedef sequence<long> LongSeq;
typedef my_any;

shall be represented in JSON as:

```
{
   "typecode": {
      "kind": "tk_sequence",
      "element_typecode": {
         "kind": "tk_long"
      }
   }
}
```
An instance of an IDL `any`, which has had an instance of an IDL struct type such as the following IDL struct named `Example` inserted into it:

```idl
struct Example {
    short member1;
    short member2;
    long member3;
};
```

shall be represented in JSON as:

```json
{
    "typecode": {
        "kind": "tk_struct",
        "id": "IDL:Example:1.0",
        "name": "Example"
    },
    "value": {
        "member1": 100,
        "member2": 50,
        "member3": 10000
    }
}
```

### 9.3 IDL Interfaces

In CORBA, an interface is a description of a set of possible operations that a client may request [CORBA 3.3, Part 1, Section 5.2.2, Requests] of an object [CORBA 3.3, Part 1, Section 5.2.1, Objects], through that interface [CORBA 3.3, Part 1, Section 5.2.5, Interface].

The following sections define the mapping between:

- an HTTP request targeting a URI resource and containing data representation of that resource in JSON format, and a CORBA request targeting the object, interface, operation, or attribute anchored to that resource.
- an HTTP response produced by a URI resource and containing data representation of that resource in JSON format, and a CORBA reply originating from the object, interface, operation, or attribute anchored to that resource.

### 9.3.1 CORBA Request and HTTP Request message body mapping

The HTTP request message body shall contain a JSON object, denoted as the `request wrapper object`.

The `request wrapper object` shall contain a JSON object member to represent each of the IDL operation parameters that have directional parameter attributes of type `in` and `inout` as follows:

- the IDL operation parameter name shall map to the JSON object member string, followed a “:” character
the IDL operation parameter value, represented in JSON according to the rules defined in JSON Data Representation format - section 9, shall map to the JSON object member element

Compliant implementations may optionally include the representation of in and inout parameters that have been annotated with an @PathParam or @QueryParam annotation in the request wrapper object.

The HTTP request header Content-Type shall be set to the value “application/json”.

9.3.1.1 HTTP Request message body example

@Path("/sample/{objkey}")
interface SampleInterface {
  /* ...

struct SampleStruct {
  string struct_member_string;
  long struct_member_long;
};

@Path("/sample_service")
interface SampleServiceInterface {
  @POST
  @Path("sample_operation")
  SampleInterface sample_operation(in long a_in_param,
                                  inout SampleStruct an_inout_param ,
                                  out string an_out_param);
};

The sample_operation() operation in parameter a_in_param and the inout parameter an_inout_param will be marshalled in the request wrapper object in the HTTP request message body.

The excerpt below shows the corresponding HTTP request message:

POST /sample_service/sample_operation HTTP/1.1
Content-Type: application/json
/* ... HTTP Header not shown ... */
{
  "a_in_param": 1234,
  "an_inout_param": {
    "struct_member_string": "a struct sample value",
    "struct_member_long": 54321
  },
}

9.3.2 CORBA Reply and HTTP Response message body mapping

The HTTP response message body shall contain a JSON object, denoted as the response wrapper object.

The response wrapper object shall contain a JSON object member to represent each of the IDL operation parameters that have directional parameter attributes of type out and inout as follows:

• the IDL operation parameter name shall map to the JSON object member name, followed by a “:” character
• the IDL operation parameter value, represented in JSON according to the rules defined in JSON Data Representation format - section 9, shall map to the JSON object member element
The response wrapper object shall contain a JSON object member to represent the IDL operation return result as follows:

- the JSON object member string “_ret”, followed by a “:” character
- the IDL return result value, represented in JSON according to the rules defined in JSON Data Representation format - section 9, shall map to the JSON object member element

The HTTP response header Content-Type shall be set to the value “application/json”.

9.3.2.1 HTTP Response message body example

```java
@Path("/sample/{objkey}")
Interface SampleInterface { /* … */}

struct SampleStruct {
    string struct_member_string;
    long struct_member_long;
};
@Path("/sample_service")
interface SampleServiceInterface {
    @POST
    @Path("sample_operation")
    SampleInterface sample_operation(in long a_in_param,
    inout SampleStruct an_inout_param ,
    out string an_out_param);
};
```

The sample_operation() operation out parameter an_out_param, the inout parameter an_inout_param, and the return result will be marshalled in the response wrapper object in the HTTP request message body.

The @Path annotation applied to the SampleInterface interface, containing the special {objkey} URI template parameter, meets the conditions defined in section 8.1.4. The ::SampleServiceInterface::sample_operation() operation returns an object reference to an instance of SampleInterface object. This results in the JSON representation of the object reference being contained in the response “_ret” JSON object member.

The excerpt below shows the corresponding HTTP response message:

```
HTTP/1.1 200 OK
Content-Type: application/json
/* … HTTP Header not shown ... */
{
    "_ret": "/account/4YYASBSDFJ3456JSDF==",
    "an_inout_param": {
        "struct_member_string": "a struct sample value",
        "struct_member_long": 54321
    },
    "an_out_param": "a sample out param string value"
}
```
9.3.3 CORBA Reply containing an exception and HTTP Response message body mapping

For CORBA replies containing a CORBA exception, the HTTP response message body shall contain a JSON object, denoted as the exception wrapper object.

The exception wrapper object shall contain a JSON object member to represent the IDL string containing the RepositoryId for the exception, as defined in the CORBA (Part 1) specification, section 14, The Interface Repository, as follows:

- the JSON object member string “exceptionRepositoryID”, followed by a “:” character
- the IDL string containing the RepositoryId for the exception value, represented in JSON according to the rules defined in String types, section 9.1.2.2, shall map to the JSON object member element

The response wrapper object shall contain a JSON object member to represent the IDL exception members as follows:

- the JSON object member string “exceptionMembers”, followed by a “:” character
- a JSON object containing the JSON representation of the members of the exception, if any. Members of an IDL exception shall be represented in JSON in the same manner as members of an IDL struct, as defined in Struct types, section 9.1.3.1.

The HTTP response header Content-Type shall be set to the value “application/json”.

9.3.3.1 HTTP Response message body exception example

```java
@Path("/sample_service")
interface SampleServiceInterface {

    exception SampleException {
        long sample_exception_id;
        string sample_exception_string;
    }

    @GET
    @Path("sample_operation")
    void sample_operation (in long a_in_param) raises SampleException;
}
```

When the IDL operation sample_operation() raises the IDL exception SampleException, the exception will be marshalled in the exception wrapper object in the HTTP response message body.

The excerpt below shows the corresponding HTTP response message:

```
HTTP/1.1 200 OK
Content-Type: application/json
/* ... HTTP Header not shown ... */
{
    "exceptionRepositoryID": "IDL:SampleServiceInterface/SampleException:1.0",
    "exceptionMembers": {
        "sample_exception_id": 10202,
        "sample_exception_string": "a sample exception string value"
    }
}
```
10 XML Data Representation format

This section specifies a mapping between IDL types and XML [XML] Data Representation (XMLDR) syntax. For the IDL types defined below, a mapping is defined to convert the data from the CORBA Common Data Representation format to XML Data Representation format and vice-versa (i.e. from CDR to XMLDR and XMLDR to CDR).

10.1 IDL Core Data Types

Instances of IDL Core Data Types are represented as an XML element:
- with the XML element name set to the IDL type identifier
- with the XML element content set to a representation of the value of the instance of the IDL type, according to the rules set out in the following subsections.

10.1.1 Basic Types

10.1.1.1 Integer types

The value of an instance of IDL integer data types: short, unsigned short, long, unsigned long, long long, and unsigned long long shall be represented as an XML element content set to the decimal string representation of the integer, as defined in IDL 4.2, Section 7.2.6.1, Integer Literals.

For example, an instance of an IDL long type defined in IDL:

```idl
global long return_code;
```

shall be represented in XML as:

```xml
<return_code>50000</return_code>
```

10.1.1.2 Floating point types

The value of an instance of IDL floating-point data types: float, double, and long double shall be represented as an XML element content set to the floating point representation of the value, as defined in IDL 4.2, Section 7.2.6.4, Floating-point Literals.

For example, an instance of an IDL float type defined in IDL:

```idl
float float_val;
```

shall be represented in XML as:

```xml
<float_val>-1.1225E8</float_val>
```

10.1.1.3 Character types

The value of an instance of IDL character data types: char, and wchar shall be represented as an XML element content set to the character representation of the value, as defined in IDL 4.2, Section 7.2.6.2, Character Literals.
For example, an instance of an IDL char type defined in IDL:

```idl
cchar char_val;
```

shall be represented in XML as:

```xml
<char_val>x</char_val>
```

### 10.1.1.4 Boolean types

The value of an instance of the IDL boolean data type shall be represented as an XML element content set to either the case-insensitive string `true` or `false`.

For example, an instance of the following IDL boolean defined in IDL:

```idl
bool boolean bool_val;
```

shall be represented in XML as:

```xml
<bool_val>false</bool_val>
```

### 10.1.1.5 Octet type

The value of an instance of the IDL octet data type shall be represented as an XML element content set to the octet representation of the value, as defined in IDL 4.2, Section 7.4.1.4.3, Constants.

For example, an instance of the following IDL octet defined in IDL:

```idl
octet octet_val;
```

shall be represented in XML as:

```xml
<octet_val>254</octet_val>
```

### 10.1.2 Template Types

#### 10.1.2.1 Sequence Types

The value of an instance of the IDL sequence data type shall be represented as an XML element content that, for each element in the IDL sequence, contains a child XML element named `item`, containing the XML representation of the value of the IDL sequence element, as specified in section 10.

For example, an instance of the following IDL sequence containing octet value 2, 3, 5:

```idl
typedef sequence<octet> octetSeq;
```

shall be represented in XML as:

```xml
<octetSeq>
  <item>2</item>
  <item>3</item>
</octetSeq>
```
10.1.2.2 String Types

The value of an instance of the IDL string and wstring data types shall be represented as an XML element content set to the representation of the value of the IDL string or wstring type, as defined in IDL 4.2, section 7.2.6.3 String Literals.

For example, an instance of the following IDL string containing “my example string”:

typedef string my_string;

shall be represented in XML as:

<my_string>my example string</my_string>

10.1.2.3 Fixed Types

The value of an instance of the IDL fixed data type shall be represented as an XML element content set to the representation of the value, as defined in IDL 4.2, section 7.2.6.5 Fixed-Point Literals (the “d” or “D” character may be omitted).

For example, an instance of the following IDL fixed type containing the value 123.45d with digits 5 and scale 2:

typedef fixed<5, 2> my_fixed;

shall be represented in XML as:

<my_fixed>123.45</my_fixed>

10.1.3 Constructed Types

10.1.3.1 Struct Types

The value of an instance of the IDL struct data type shall be represented as an XML element content that, for each struct member of the IDL struct, contains a child XML element with the name set to the struct member identifier, containing the XML representation of the value of the IDL struct member value, as specified in section 10.

For example, an instance of the following IDL struct type, with string_val member set to “Joe Bloggs”, char_val member set to “c”, octet_val set to 200, short_val set to 10000, long_val set to -2323424, ulonglong_val set to 3424234243:

struct StructType {
    string string_val;
    char char_val;
    octet octet_val;
    short short_val;
    long long_val;
    unsigned long long ulonglong_val;
};

shall be represented in XML as:
10.1.3.2 Enum Types

The value of an instance of the IDL enum data type shall be represented as an XML element content set to the string representation of one of the valid values of the IDL enum.

For example, an instance of the following IDL enum with value set to RED:

```cpp
enum Color {RED, GREEN, BLUE};
```

shall be represented in XML as:

```xml
<Color>RED</Color>
```

10.1.3.3 Union Types

The value of an instance of the IDL union type shall be represented as an XML element content that contains:

- a child XML element named discriminator, with the XML element content set to either:
  - the XML representation, as defined in section 10, of the value of the case label of the IDL union discriminator type, if the value of the case label matches one of the cases of the union.
  - _default, if the default case of the union is selected.
- a child XML element named value, containing the XML representation, as defined in section 10, of the value of the IDL union case type selected by the discriminator.

For example, an instance of the following IDL union with discriminator set to LEFT and value set to 10.5:

```cpp
enum Direction {UP, DOWN, LEFT, RIGHT, NONE, UNKNOWN};
union Movement switch(Direction) {
  case UP:
  case DOWN:
  case LEFT:
  case RIGHT:
    float distance;
  case NONE:
    long time_still;
  default:
    short error_code;
};
```

shall be represented in XML as:
An instance of the previously defined Movement IDL union with discriminator set to UNKNOWN and value set to 255 shall be represented in XML as:

```xml
<Movement>
  <discriminator>_default</discriminator>
  <value>255</value>
</Movement>
```

### 10.1.3.4 Array Types

The value of an instance of an IDL array data type shall be represented in XML according to the same rules as specified for IDL sequence types, as defined in section 10.1.2.1.

### 10.1.3.5 Native Types

A native type may be used only to define IDL operation parameters and results. Native type parameters are permitted only in operations of local interfaces or valuetypes. Native types cannot be used as operation parameters or results in remote invocations. As such, no XML data representation mapping of native types is specified.

### 10.2 IDL Any type

An IDL any type instance shall be represented as an XML element with the same name as the any type, containing:

- a child XML element named typecode, containing the XML representation of the TypeCode, as defined in section 10.2.1
- a child XML element named typecode, containing the XML representation of the TypeCode, as defined in section 10.2.1

### 10.2.1 TypeCode

In CORBA Common Data Representation (CDR) transfer syntax (the format in which the GIOP represents OMG IDL data types in an octet stream), TypeCodes are encoded as the TCKind enum value, followed by zero or more TypeCode parameter values. The encodings of the parameter lists fall into three general categories:

- TypeCodes with an empty parameter list
- TypeCodes with simple parameter lists
- TypeCodes with complex parameter lists

Table 9.2 in section 9.3.5.1.2, TypeCode Parameter Notation, of the CORBA Specification, 3.3, part 2, defines the type (i.e. empty, simple, complex parameter list) for each TypeCode TCKind enum value in the Type column and defines the ordered list of TypeCode parameters in the Parameters column.

The JSON representation of an instance of a TypeCode is correspondingly dependent on the TypeCode parameter list encoding rules defined by the CORBA specification, as defined in the following subsections.
10.2.1.1 Empty parameter list TypeCode

An empty parameter list TypeCode instance shall be represented as an XML element named typecode, containing a child XML element named kind, containing the XML representation of the TypeCode’s TCKind enum value as defined in section 10.1.3.2.

10.2.1.1.1 Empty parameter TypeCode example

A TypeCode with a TCKind of tk_long describing a IDL long type such as:

typedef long my_long;

shall be represented in XML as:

```xml
<typecode>
  <kind>
    <TCKind>tk_long</TCKind>
  </kind>
</typecode>
```

10.2.1.2 Simple parameter list TypeCode

A simple parameter list TypeCode is a typecode with a TCKind enum value set to either tk_string, tk_wstring, or tk_fixed.

10.2.1.2.1 TypeCodes with TCKind tk_string or tk_wstring

A simple parameter list TypeCode instance with TCKind equal to either tk_string or tk_wstring shall be represented as an XML element named typecode containing:

- a child XML element named kind, containing the XML representation of the TypeCode’s TCKind enum value as defined in section 10.1.3.2.
- a child XML element named bound containing the XML representation of the IDL unsigned long parameter defining the bound of the IDL string or wstring type, as defined in section 10.1.1.1. The content of the bound XML element shall be set to 0 for unbounded IDL string.

Simple parameter list TypeCode with TCKind set to tk_string or tk_wstring examples

A TypeCode with a TCKind of tk_string describing a bounded IDL string type such as:

typedef string<80> bounded_string;

shall be represented in XML as:

```xml
<typecode>
  <kind>
    <TCKind>tk_string</TCKind>
  </kind>
  <bound>80</bound>
</typecode>
```
10.2.1.2.2 TypeCodes with TCKind set to tk_fixed

A simple parameter list TypeCode instance with TCKind equal to tk_fixed shall be represented as an XML element named typecode containing:

- a child XML element named kind, containing the XML representation of the TypeCode’s TCKind enum value as defined in section 10.1.3.2.
- a child XML element named digits containing the XML representation of the IDL unsigned short parameter defining the digits of the IDL fixed type, as defined in section 10.1.1.1.
- a child XML element named scale containing the XML representation of the IDL short parameter defining the scale of the IDL fixed type, as defined in section 10.1.1.1.

Simple parameter list TypeCode with TCKind tk_fixed examples

A TypeCode with a TCKind of tk_fixed describing an IDL fixed type such as:

typedef fixed<5, 2> my_fixed;

shall be represented in XML as:

```xml
<typecode>
  <kind>
    <TCKind>tk_fixed</TCKind>
  </kind>
  <digits>5</digits>
  <scale>2</scale>
</typecode>
```

10.2.1.3 Complex parameter list TypeCode

10.2.1.3.1 TypeCodes with TCKind tk_sequence or tk_array

A complex parameter list TypeCode instance with TCKind equal to tk_sequence or tk_array shall be represented as an XML element named typecode, containing:

- a child XML element named kind, containing the XML representation of the TypeCode’s TCKind enum value as defined in section 10.1.3.2.
- a child XML element named element_typecode, containing the XML representation, as defined in section 10.2.1, of the TypeCode describing the type of the elements contained within the IDL sequence or array.
- a child XML element named length, containing the XML representation, as defined in section 10.1.1.1, of the IDL unsigned long parameter defining the length the IDL array or the maximum length of the IDL sequence. The content of the length XML element shall be set to 0 for TypeCodes representing an unbounded IDL sequence.

Complex parameter list TypeCode with TCKind tk_sequence or tk_array examples

A TypeCode with a TCKind of tk_sequence describing an unbounded IDL sequence type such as:

typedef sequence<long> LongSeq;

shall be represented in XML as:

```xml
<typecode>
  <kind>
</typecode>
```
<TCKind>tk_sequence</TCKind>
</kind>
<element_typecode>
   <TCKind>tk_long</TCKind>
</element_typecode>
<bound>0</bound>
</typecode>

10.2.1.3.2 TypeCodes with TCKind other than tk_sequence or tk_array

All other complex parameter list TypeCode instances shall be represented as an XML element named typecode, containing:

- a child XML element named kind, containing the XML representation of the TypeCode’s TCKind enum value as defined in section 10.1.3.2.
- a child XML element named id, containing the XML representation of the CORBA::RepositoryId value returned by the TypeCode::id() operation, for TypeCode instances that allow the id() operation to be invoked, as defined in the CORBA specification 3.3, part 1, section 8.11.1.
- a child XML element named name, containing the XML representation of the CORBA::Identifier value returned by the TypeCode::name() operation, for TypeCode instances that allow the name() operation to be invoked, as defined in the CORBA specification 3.3, part 1, section 8.11.1.

Complex parameter list TypeCode with TCKind other than tk_sequence or tk_array examples

A TypeCode with a TCKind of tk_struct describing an IDL struct type such as the following IDL struct named Example:

```idl
data Example {
   short member1;
   short member2;
   long member3;
};
```

shall be represented in XML as:

```xml
<typecode>
  <kind>
    <TCKind>tk_struct</TCKind>
  </kind>
  <idIDL:Example:1.0/id>
  <name>Example</name>
</typecode>
```

10.2.2 Any examples

10.2.2.1 Empty parameter list Any examples

An instance of an IDL any, which has had an instance of an IDL long type with a value of 10 inserted into it:

```cpp
typedef long my_long;
typedef any my_any;
```
shall be represented in XML as:

```xml
<my_any>
  <typecode>
    <kind>
      <TCKind>tk_long</TCKind>
    </kind>
  </typecode>
  <value>10</value>
</my_any>
```

10.2.2.2 Simple parameter list Any examples

An instance of an IDL `any`, which has had an instance of an IDL bounded `string` type with a `bound` of 80 and a value of “example string” inserted into it:

```c
typedef string<80> bounded_string;
typedef any my_any;
```

shall be represented in XML as:

```xml
<my_any>
  <typecode>
    <kind>
      <TCKind>tk_string</TCKind>
    </kind>
    <bound>80</bound>
  </typecode>
  <value>example string</value>
</my_any>
```

An instance of an IDL `any`, which has had an instance of an IDL `fixed` type, with parameters `digits` equal to 5 and `scale` equal to 2 and a value of 123.45, inserted into it:

```c
typedef fixed<5, 2> my_fixed;
typedef any my_any;
```

shall be represented in XML as:

```xml
<my_any>
  <typecode>
    <kind>
      <TCKind>tk_fixed</TCKind>
    </kind>
    <digits>5</digits>
    <scale>2</scale>
  </typecode>
  <value>123.45</value>
</my_any>
```
### 10.2.2.3 Complex parameter list Any examples

An instance of an IDL `any`, which has had an instance of an IDL unbounded sequence of IDL `long` elements inserted into it:

```c
typedef sequence<long> LongSeq;
typedef my_any;
```

shall be represented in XML as:

```xml
<my_any>
  <typecode>
    <kind>
      <TCKind>tk_sequence</TCKind>
    </kind>
    <element_typecode>
      <kind>
        <TCKind>tk_long</TCKind>
      </kind>
    </element_typecode>
    <bound>0</bound>
  </typecode>
  <value>
    <item>1</item>
    <item>1</item>
    <item>2</item>
    <item>3</item>
    <item>5</item>
    <item>8</item>
  </value>
</my_any>
```

An instance of an IDL `any`, which has had an instance of an IDL struct type such as the following IDL struct named `Example` inserted into it:

```c
struct Example {
  short member1;
  short member2;
  long member3;
};
```

shall be represented in XML as:

```xml
<my_any>
  <typecode>
    <kind>
      <TCKind>tk_struct</TCKind>
    </kind>
    <id>IDL:Example:1.0</id>
    <name>Example</name>
  </typecode>
  <value>
    <member1>100</member1>
    <member2>50</member2>
  </value>
</my_any>
```
10.3 IDL Interfaces

In CORBA, an interface is a description of a set of possible operations that a client may request [CORBA 3.3, Part 1, Section 5.2.2, Requests] of an object [CORBA 3.3, Part 1, Section 5.2.1, Objects], through that interface [CORBA 3.3, Part 1, Section 5.2.5, Interface].

The following sections define the mapping between:
- an HTTP request targeting a URI resource and containing data representation of that resource in XML format, and a CORBA request targeting the object, interface, operation, or attribute anchored to that resource.
- an HTTP response produced by a URI resource and containing data representation of that resource in XML format, and a CORBA reply originating from the object, interface, operation, or attribute anchored to that resource.

10.3.1 CORBA Request and HTTP Request message body mapping

The HTTP request message body shall contain an XML document containing in its root an XML element, denoted as the request wrapper element.

The name of the request wrapper element XML element shall be set as follows:
- The IDL operation name, or IDL attribute name is converted to Pascal case, with the first character replaced with an uppercase character. All underscore characters will be removed, and the character that was immediately following any underscore character is to replaced with an uppercase character.
- The text Request is then appended.

The request wrapper element shall contain XML elements to represent each of the IDL operation parameters that have directional parameter attributes of type in and inout as follows:
- the IDL operation parameter name shall map to an XML element of the same name.
- the IDL operation parameter value, represented in XML according to the rules defined in XML Data Representation format - section 10, shall map to the XML element value.

Compliant implementations may optionally include the representation of in and inout parameters that have been annotated with an @PathParam or @QueryParam annotation in the request wrapper element.

The HTTP request header Content-Type shall be set to the value “application/xml”.

10.3.1.1 HTTP Request message body example

@Path("/sample/{objkey}")
Interface SampleInterface { /* ... */}

struct SampleStruct {
    string struct_member_string;
    long struct_member_long;
};

@Path("/sample_service")
interface SampleServiceInterface {


@POST
@Path("sample_operation")
SampleInterface sample_operation(
in long a_in_param,
inout SampleStruct an_inout_param,
out string an_out_param);
}

The IDL operation sample_operation() operation in parameter a_in_param and the inout parameter an_inout_param will be marshalled in the request wrapper element in the HTTP request message body.

The excerpt below shows the corresponding HTTP request message:

POST /sample_service/sample_operation HTTP/1.1
Content-Type: application/xml
/* … HTTP Header not shown … */

<SampleOperationRequest>
  <a_in_param>1234</a_in_param>
  <an_inout_param>
    <SampleStruct>
      <struct_member_string>a struct sample value</struct_member_string>
      <struct_member_long>54321</struct_member_long>
    </SampleStruct>
  </an_inout_param>
</SampleOperationRequest>

10.3.2 CORBA Reply and HTTP Response message body mapping

The HTTP response message body shall contain an XML document containing in its root an XML element, denoted as the response wrapper element.

The name of the response wrapper element XML element shall be set as follows:
- The IDL operation name, or IDL attribute name is converted to Pascal case, with the first character replaced with an uppercase character. All underscore characters will be removed, and the character that was immediately following any underscore character is to replaced with an uppercase character.
- The text Response is then appended.

The response wrapper element shall contain XML elements to represent each of the IDL operation parameters that have directional parameter attributes of type out and inout as follows:
- the IDL operation parameter name shall map to an XML element of the same name.
- the IDL operation parameter value, represented in XML according to the rules defined in XML Data Representation format - section 10, shall map to the XML element value.

The response wrapper object shall contain an XML elements to represent IDL operation return result as follows:
- the IDL return result shall map to the XML element <_ret>
- the IDL return result value, represented in XML according to the rules defined in XML Data Representation format - section 10, shall map to the XML element value.

The HTTP response header Content-Type shall be set to the value “application/xml”.

10.3.2.1 HTTP Response message body example

@Path("/sample/{objkey}")
Interface SampleInterface { /* ... */}

struct SampleStruct {
    string struct_member_string;
    long struct_member_long;
};

@Path("/sample_service")
interface SampleServiceInterface {
    @POST
    @Path("sample_operation")
    SampleInterface sample_operation(in long a_in_param, 
inout SampleStruct an_inout_param , 
    out string an_out_param);
}

The IDL operation sample_operation() out parameter an_out_param, the inout parameter an_inout_param, and the return result will be marshalled in the response wrapper element in the HTTP request message body.

The @Path annotation applied to the SampleInterface interface, containing the special {objkey} URI template parameter, meets the conditions defined in section 8.1.4. The ::SampleServiceInterface::sample_operation() operation returns an object reference to an instance of SampleInterface object. This results in the JSON representation of the object reference being contained in the response <_ret></_ret> XML element.

The excerpt below shows the corresponding HTTP response message:

HTTP/1.1 200 OK
Content-Type: application/xml
/* ... HTTP Header not shown ... */
<SampleOperationResponse>
    <an_inout_param>
        <SampleStruct>
            <struct_member_string>a struct sample value</struct_member_string>
            <struct_member_long>54321</struct_member_long>
        </SampleStruct>
    </an_inout_param>
    <an_out_param>a sample out param string value</an_out_param>
</SampleOperationResponse>

10.3.3 CORBA Reply containing an exception and HTTP Response message body mapping

For CORBA replies containing a CORBA exception, the HTTP response message body shall contain an XML document containing in its root an XML element, denoted as the exception wrapper element.

The name of the exception wrapper element XML element shall be set as follows:

- The IDL operation name, or IDL attribute name is converted to Pascal case, with the first character replaced with an uppercase character. All underscore characters will be removed, and the character that was immediately following any underscore character is to replaced with an uppercase character.
- The text Exception is then appended.
The exception wrapper element shall contain an XML element to represent the IDL string containing the RepositoryId for the exception, as defined in the Interface Repository clause of CORBA (Part 1), as follows:

• the XML element `<exceptionRepositoryID>`, containing:
  • the IDL string containing the RepositoryId for the exception value, represented in XML according to the rules defined in XML Data Representation format - section 10, shall map to the XML element value.

The exception wrapper element shall contain an XML element to represent the IDL exception members as follows:

• the XML element `<exceptionMembers>`, containing:
  • the XML representation of the members of the exception, if any. Members of an IDL exception shall be represented in XML in the same manner as members of an IDL struct, as defined in Struct Types, section 10.1.3.1.

The HTTP response header `Content-Type` shall be set to the value “application/xml”.

10.3.3.1 HTTP Response message body exception example

```java
@Path("/sample_service")
interface SampleServiceInterface {

  exception SampleException {
    long sample_exception_id;
    string sample_exception_string;
  };

  @GET
  @Path("/sample_operation")
  void sample_operation (in long a_in_param) raises SampleException;
}
```

When the IDL operation `sample_operation()` raises the IDL exception `SampleException`, this exception will be marshalled in the response wrapper element in the HTTP response message body.

The excerpt below shows the corresponding HTTP response message:

```
HTTP/1.1 200 OK
Content-Type: application/xml
/* ... HTTP Header not shown ... */
<SampleOperationException>
  <exceptionRepositoryID>IDL:SampleServiceInterface/SampleException:1.0</exceptionRepositoryID>
  <exceptionMembers>
    <sample_exception_id>10202</sample_exception_id>
    <sample_exception_string>a sample exception string value</sample_exception_string>
  </exceptionMembers>
</SampleOperationException>
```
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Appendix A. Exposing a REST API to a sample CORBA application (Non-Normative)

This appendix walks through the steps involved in exposing a REST API to a sample CORBA application using the IDL-RS annotations. The resulting REST API can then be consumed by REST client applications to invoke the services provided by the CORBA application via REST.

This appendix covers the following topics:
- Overview of the sample CORBA Image Processing application
- Defining the desired REST API to the CORBA Image Processing application
- Annotating the CORBA Image Processing application IDL with IDL-RS annotations
- Example output of an interaction with the REST API to the CORBA Image Processing application

A.1. Example CORBA Image Processing Application overview

The example application provides facilities to manipulate graphical images and apply image transformations such as grayscale or sharpen to the images. These manipulation and transformation facilities are implemented on the server side by the following CORBA Objects:
- an `ImageFactory` interface, which can receive/create and store Images; and
- an `Image` interface, which provides the capability to apply image transformations.

A typical CORBA client would use the CORBA operations defined in the above interfaces:
- the `ImageProcessing::ImageFactory::create_image()` IDL operation, to send the image data to the CORBA Server for the creation of an Image Object.
- the `ImageProcessing::ImageFactory::list_images()` IDL operation, used to retrieve a list of CORBA Object references to the corresponding Image Objects located in the server.
- the `ImageProcessing::Image` interface provides several image transformation operations such as: `grayscale()`, `sharpen()`, and `edge_detection()`.
- the `ImageProcessing::Image` interface also provides a `delete_image()` operation, used to destroy instances of Image Objects.

The IDL for this Image Processing application is listed below:

```idl
module ImageProcessing {
    __exception UnknownImageFormat {
        // complete
    }:

    __interface Image {
        typedef sequence<octet> ImagePayload;
        typedef sequence<Image> ImageSeq;

        __interface ImageFactory {
            __{ Image create_image(in ImagePayload imgBytes) raises(UnknownImageFormat); }
    }
}
```

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ImageSeq list_images();
);

interface Image
{
    readonly attribute ImagePayload img_data;
    void grayscale();
    void sharpen();
    void edge_detection();
    void declassify();
    void delete_image();
};

The first step in applying the REST for CORBA Specification is to annotate the IDL file above using the IDL-RS annotations, as specified in section 8.

A.2. Defining the REST API to the CORBA server

The following table outlines the desired REST API associated to the CORBA IDL interfaces, operations and attributes.

<table>
<thead>
<tr>
<th>Desired REST API</th>
<th>Corresponding mapped IDL Operation/Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>POST /image-processing</td>
<td>MF_ImageProcessing::ImageFactory::create_image()</td>
</tr>
<tr>
<td>GET /image-processing</td>
<td>MF_ImageProcessing::ImageFactory::create_image()</td>
</tr>
<tr>
<td>GET /image-processing/images/{objkey}</td>
<td>MF_ImageProcessing::Image::img_data()</td>
</tr>
<tr>
<td>POST /image-processing/images/{objkey}/grayscale</td>
<td>MF_ImageProcessing::Image::grayscale()</td>
</tr>
<tr>
<td>POST /image-processing/images/{objkey}/sharpen</td>
<td>MF_ImageProcessing::Image::sharpen()</td>
</tr>
<tr>
<td>POST /image-processing/images/{objkey}/edge-detection</td>
<td>MF_ImageProcessing::Image::edge_detection()</td>
</tr>
<tr>
<td>POST /image-processing/images/{objkey}/declassify</td>
<td>MF_ImageProcessing::Image::declassify()</td>
</tr>
<tr>
<td>DELETE /image-processing/images/{objkey}</td>
<td>MF_ImageProcessing::Image::delete_image()</td>
</tr>
</tbody>
</table>

Table A.1: Mapping CORBA API to desired REST API
A.3. Annotating IDL with IDL-RS annotations

The desired REST API can be realized by applying IDL-RS annotation to the original IDL file as follows (IDL-RS annotations are emphasized using a **bold** typeface):

```idl
module ImageProcessing {
    exception UnknownImageFormat {
        // complete
    };
    interface Image {
    }
    typedef sequence<octet> ImagePayload;
    typedef sequence<Image> ImageSeq;

    @Path(uri = "/image-processing", rir = "corbaloc::example.com:8080/ImageFactory")
    interface ImageFactory {
        @POST
        Image create_image(in ImagePayload imgBytes) raises(UnknownImageFormat);

        @GET
        ImageSeq list_images();
    };

    @Path("/images/{objkey}")
    interface Image {
        @GET
        readonly attribute ImagePayload img_data;

        @Path("grayscale")
        @POST
        void grayscale();

        @Path("sharpen")
        @POST
        void sharpen();

        @Path("edge-detection")
        @POST
        void edge_detection();

        @Path("declassify")
        @POST
        void declassify();

        @DELETE
        void delete_image();
    };
}
```

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A.4. Example output from REST client interaction

The example that follows demonstrates a typical interaction between a simple REST client application and the REST API defined above. The example used the well-known command-line tool curl.

The following curl commands invoke a HTTP GET request on the URI /image-processing which maps to the ImageFactory CORBA Object. The HTTP response from this URI returns a collection of URIs which identify unique REST resources representing Image instances in the server. Note the use of the HTTP Accept header to control the data representation format in the response.

```
# curl -s http://example.com:8080/image-processing -H 'Accept: application/xml' | xmllint --format -
<?xml version="1.0"?><list_imagesResponse xmlns="">
  _ret_
  <item>/images/AVZCAQIAAAAvACAgAQAAADAgICCcwfdhiDwOAA==</item>
  <item>/images/AVZCAQIAAAAvACAgAQAAAADEgICCcwfdhiDwOAA==</item>
  <item>/images/AVZCAQIAAAAvACAgAQAAAADEgICCcwfdhiDwOAA==</item>
</list_imagesResponse>
```

```
# curl -s http://example.com:8080/image-processing -H 'Accept: application/json' | json_pp
{
  _ret_ : ["/images/AVZCAQIAAAAvACAgAQAAADAgICCcwfdhiDwOAA==",
            "/images/AVZCAQIAAAAvACAgAQAAAADEgICCcwfdhiDwOAA==",
            "/images/AVZCAQIAAAAvACAgAQAAAADEgICCcwfdhiDwOAA=="
  ]
}
```

The following curl command invokes a HTTP GET request on the URI /image-processing/images/{objkey} which identifies a unique Image resource. The {objkey} URI path template parameter is used to uniquely identify a REST resource and the corresponding CORBA object, as specified in section 8.1.4, Obtaining string representations of IDL object references.

The HTTP response from this API contains the source Image encoded in the chosen media type (the binary data is omitted in the listing below).

```
# curl -s http://example.com:8080/image-processing/images/AVZCAQIAAAAvACAgAQAAAADEgICCcwfdhiDwOAA==
-H 'Accept: application/json'
{
  _ret_ : [137,80,78,71,13,10,26,10,0,0,0,13,73,72,68,82,0,0,4,0,0,0,2,179,8,2,
            ...
            ...OMITTED...
  ]
}
```

The following curl command invokes a HTTP POST request on the URI /image-processing/images/{objkey}/edge-detection. This URI extends the URI invoked upon in the previous command by appending edge-detection and results in the invocation of a transformation on the image.
The following curl command invokes a HTTP DELETE request on the URI `/image-processing/images/{objkey}` which identifies a unique image REST resource. The corresponding CORBA `ImageProcessing::Images::delete_image()` IDL operation will be executed on Image object mapped to the URI.

```
# curl -s http://example.com:8080/image-processing/images/AVZCAQIAAAAvACAgAQAAADAgICCcwfdhiDwOAA== -X DELETE
```

The final curl command repeats the first example invocation to demonstrate that the available image resources have now been reduced as a result of the previous HTTP DELETE curl command invocation.

```
# curl -s http://example.com:8080/image-processing | json_pp
{
  "ret" : [
    "/images/AVZCAQIAAAAvACAgAQAAADAgICCcwfdhiDwOAA==",
    "/images/AVZCAQIAAAAvACAgAQAAADAgICCcwfdhiDwOAA=="
  ]
}
```
Appendix B. Securing a REST for CORBA application (Non-Normative)

This appendix illustrates how security might be added to the example REST for CORBA application described in Appendix A.

A valid approach would entail the deployment of the REST for CORBA application in a webserver that offers Transport Layer Security capabilities. TLS security certificates can be configured at the REST service endpoint and at REST client endpoints. This would enable authentication, confidentiality and integrity in the communication between the REST clients and the REST service endpoint.

The following example demonstrates how to consume the secured REST for CORBA application described in Appendix A. (some output has been omitted for brevity):

```bash
# curl -v --cacert <path-to-ca-certificate> --cert <path-to-client-certificate> --key <path-to-client-private-key> https://example.com:8080/image-processing | json_pp
* TLSv1.3 (OUT), TLS handshake, Client hello (1):
* TLSv1.3 (IN), TLS handshake, Server hello (2):
 * TLSv1.2 (IN), TLS handshake, Certificate (11):
 * TLSv1.2 (IN), TLS handshake, Server key exchange (12):
 * TLSv1.2 (IN), TLS handshake, Request CERT (13):
 * TLSv1.2 (IN), TLS handshake, Server finished (14):
 * TLSv1.2 (OUT), TLS handshake, Certificate (11):
 * TLSv1.2 (OUT), TLS handshake, Client key exchange (16):
 * TLSv1.2 (OUT), TLS handshake, CERT verify (15):
 * TLSv1.2 (OUT), TLS change cipher, Change cipher spec (1):
 * TLSv1.2 (OUT), TLS handshake, Finished (20):
 * TLSv1.2 (IN), TLS handshake, Finished (20):
 * SSL connection using TLSv1.2 / ECDHE-RSA-AES256-GCM-SHA384
 * Server certificate:
  ...OMITTED...
 > GET /image-processing HTTP/1.1
 > Host: example.com:8080
 > User-Agent: curl/7.76.1
 > Accept: */*
  ...OMITTED...
{
  "_ret": [
    "/images/AVZCAQIAAAAvACAgAQAAADAgICCcwfdhiDwOAA==",
    "/images/AVZCAQIAAAAvACAgAQAAADIgICCcwfdhiDwOAA=="
  ]
}
```