

**Date:**August 11, 2008

# GIOP Compression RFP initial submission

In response to OMG RFP mars/2007-06-10

mars/2008-xx-xx

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# Preface

## About this Specification

### Overview of this Specification

This RFP initial submission from Remedy IT and Telefónica I+D is based on the GIOP Compression RFP initial submission presented by IONA and Remedy IT as mars/2007-11-02.

### Intended Audience

CORBA vendors and users

### Organization of this Specification

This specification describes the compression and ZIOP additions to the CORBA specification

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### Platform Specific Model and Interface Specifications

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# 1 Scope

This specification defines a compression mechanism for the CORBA GIOP protocol. Such a mechanism provides a way for servers to publish objects which accept compressed requests and for clients to make compressed invocations. Pluggable compression algorithms could additionally be defined by clients.

# 2 Conformance

This specification defines two conformance points. ORB implementations must support at least one of these conformance points:

- A default compressor based on the zlib compression algorithm
- A plug-in mechanisms to register compressors

ORB implementations may optionally support other compressors based on others standard compression algorithms.

# 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.

- OMG CORBA 3.0.3 specification

# 4 Terms and Definitions

For the purposes of this specification, the terms and definitions given in the normative reference and the following apply.

## **Policy**

The term policy in this document describes CORBA objects that implement the CORBA::Policy interface. See CORBA 3.0.3, chapter 4.8.1

## **Compressor**

An entity which provides compression and decompression of octet sequences.

## **CompressionRatio**

The numerical relation between compressed and original uncompressed sequences.

# 5 Symbols

List of symbols/abbreviations.

ZIOP - Zipped Inter-ORB protocol

GIOP - Generic Inter-ORB protocol

ORB - Object Request Broker

CORBA - Common Object Request Broker Architecture

IOR - Interoperable Object Reference

## 6 Additional Information

### 6.1 Changes to Adopted OMG Specifications

This specification adds the following to CORBA 3.0.3 specification:

- A set of new POA Policies: `CompressionEnablingPolicy`, `CompressionIdLevelListPolicy`, `CompressionLowValuePolicy`, `CompressionMinRatioPolicy`
- A new initial reference retrievable from the ORB's `resolve_initial_references` operation: `CompressionManager`
- A new Request/Reply message body with compressed data.

### 6.2 How to Read this Specification

The rest of this document contains the technical content of this specification.

### 6.3 Acknowledgements

The following companies submitted and/or supported parts of this specification:

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### 6.4 Proof of Concept

This submission describes the ZIOP pluggable protocol implemented lately in `TIDorbC++` by Telefonica I+D and TAO by Remedy IT.

## 7 Description

Many CORBA applications are deployed in environments with restricted bandwidth. Examples of these environments include aviation and retail banking, where applications may operate over a wide area network. Although GIOP is performant when compared to other protocols, some further optimization is possible, by minimizing the amount of information passed across the network through compression.

### 7.1 Goal

CORBA is deployed in numerous areas where the bandwidth is restricted. Such environments may operate with antiquated network infrastructure, or the network infrastructure may be overloaded. In such environments, reducing the bandwidth used by each communication request made between a client and server is desirable.

An example of such an environment is aviation, where a relatively large amount of information (such a flight charts, passenger and route data) must be passed to a remote location in a timely manner.

Another example would be retail banking, particularly in developing economies, where remote bank branches may be connected to a central server only over a dial-up modem connection.

A rise on the CPU overload is expected in this environment in order to reduce data length to be transmitted by the wire.

It is needed to define a configurable way to indicate in which circumstances (source data length, compressed ratio obtained) compression is applied or not.

### 7.2 ZIOP Overview

The new ZIOP protocol is the result to apply compression to GIOP. ZIOP is the same as GIOP Compression. ZIOP is the way to introduce compression between CORBA parties with the aim to reduce the amount of data to be transmitted on the wire. In a CORBA communication which uses ZIOP protocol, the data part of a GIOP message is compressed using a specific compression algorithm. For this purpose a compressed message is be defined as ZIOP message.

A set of new compression CORBA Policies related with ZIOP are defined to activate and communicate to other ORBs the available compression functionalities.

The compression features will be provided to ZIOP protocol by some entities. The Compressor which will be in charge of basic compression and decompression operations. The CompressorFactory will create Compressors and then CompressorFactory will be registered by the CompressionManager interface.

ORB vendors may deliver ZIOP through pluggable compressors or supply a standard and well known compression algorithm.

### 7.3 Compression Module Interfaces

The Compression module provides a set of interfaces to create and register entities which provides compression and decompression functionalities. These features may be used in stand-alone mode, to obtain compressed and decompressed CORBA octet sequences, or internally by ORB to compress GIOP messages when ZIOP protocol is enabled.

The Compressor interface is an abstraction which provides the basic mechanism to compress and decompress CORBA octet sequences. The compressor collects statistical information about its compression. A specific compressor is identified by its CompressorId. CompressorIds are maintained by the OMG, vendors and users must request specific CompressorIds for their own compressors.

The CompressorFactory interface is a factory to create different compressors using a particular algorithm depending on its compression level.

The CompressionManager interface is an ORB initial reference for register CompressorFactories depending on its compression algorithm.

All these entities, Compressor, CompressorFactory and CompressionManager are local CORBA interfaces.

The Compression module provides the way to easily create custom compressors. The procedure involves two steps. First, the user provides an implementation of CompressorFactory and Compressor interfaces. Second, this new custom CompressorFactory must be registered in the CompressionManager to make it accessible through the ORB services.

The zlib compressor must be provided by default and may be used easily as another CORBA feature. Also it is possible to implement a new custom compressor by implementing the Compressor interface.

### 7.3.1 Compressor interface

This interface is an abstraction of a specific algorithm for compression and decompression. All different algorithms implementations will support this common interface.

```
// IDL
module Compression {
    exception CompressionException {
        unsigned long reason;
    };
    typedef CORBA::OctetSeq Buffer;
    typedef unsigned long CompressionLevel;
    typedef long CompressionRatio;
    local interface Compressor {
        void compress(
            in Buffer source,
            inout Buffer target)
            raises (CompressionException);
        void decompress(
            in Buffer source,
            inout Buffer target)
            raises (CompressionException);
        readonly attribute CompressorFactory compressor_factory;
        readonly attribute CompressionLevel compression_level;
        readonly attribute unsigned long long compressed_bytes;
        readonly attribute unsigned long long uncompressed_bytes;
        readonly attribute CompressionRatio compression_ratio;
    };
};
```

### 7.3.1.1 compress

This operation compresses the data contained in a source buffer into the target buffer. If an error occurs during the compression, it throws a `CompressionException`. The buffer may be an octet sequence or an ORB specific data type.

### 7.3.1.2 decompress

This operation decompresses the data contained in the source buffer into the target buffer. If an error occurs during the decompression, it throws a `CompressionException`. The buffer may be an octet sequence or an ORB specific data type.

### 7.3.1.3 compressor\_factory

This attribute represents the object reference to `CompressorFactory` which created this `Compressor`.

### 7.3.1.4 compression\_level

This attribute represents, for the specific algorithm, the compression level that will be applied using this `Compressor`. For ZIOP we define that a low value stands for a low compression, a high value for better compression.

### 7.3.1.5 compressed\_bytes

This attribute represents the total number of compressed bytes written by this compressor (i.e. the "target" side of `Compressor::compress`). This information could be useful for statistical purposes.

### 7.3.1.6 uncompressed\_bytes

This attribute represents the total number of uncompressed bytes read by this compressor (i.e. the "source" side of `Compressor::compress`). This information could be useful for statistical purposes.

### 7.3.1.7 compression\_ratio

This attribute represents the compression ratio achieved by this compressor. The ratio must be obtained with the following formula:  $100 - (\text{compressed\_length} / \text{original\_length}) * 100$ .

## 7.3.2 CompressorFactory Interface

The `CompressorFactory` interface allows the retrieval of a `Compressor` with a particular algorithm implementation. `Compressors` are retrieved for a specific compression level.

```
// IDL
local interface CompressorFactory {
    readonly attribute CompressorId compressor_id;

    Compressor get_compressor(in CompressionLevel compression_level);
};
```

### 7.3.2.1 compressor\_id

This attribute represents the specific compression algorithm associated with this CompressorFactory. All Compressors retrieved from this factory use this algorithm.

### 7.3.2.2 get\_compressor

This operation retrieves a Compressor instance with the given compression level.

## 7.3.3 CompressionManager Interface

This is the interface to register and unregister CompressorFactories objects with an ORB. It is obtained by resolving initial references: "CompressionManager"

```
// IDL
exception FactoryAlreadyRegistered {
};
exception UnknownCompressorId {
};
local interface CompressionManager {
    void register_factory(
        in CompressorFactory compressor_factory)
        raises (FactoryAlreadyRegistered);
    void unregister_factory(
        in CompressorId compressor_id)
        raises (UnknownCompressorId);
    CompressorFactory get_factory(
        in CompressorId compressor_id)
        raises (UnknownCompressorId);
    Compressor get_compressor(
        in CompressorId compressor_id,
        in CompressorLevel compression_level)
        raises (UnknownCompressorId);
    CompressorFactorySeq get_factories();
};
```

### 7.3.3.1 register\_factory

This operation registers a new CompressorFactory.

### 7.3.3.2 unregister\_factory

This operation unregisters a CompressorFactory with the given CompressorId from the CompressionManager.

### 7.3.3.3 get\_factory

This operation retrieves a CompressorFactory with the given CompressorId from the CompressionManager.

### 7.3.3.4 get\_compressor

This operation retrieves a Compressor with the given compression\_level from the CompressorFactory with the given CompressorId.

### 7.3.3.5 get\_factories

This operation lists all registered CompressorFactories in the CompressionManager.

## 7.3.4 Compression Usage Scenario

This subsection provides an example about how to use Compression facilities.

```
CORBA::ORB_var orb = CORBA::ORB_init (argc, argv);

CORBA::Object_var cm_obj =
    orb->resolve_initial_references("CompressionManager");
Compression::CompressionManager_var cm =
    Compression::CompressionManager::_narrow(cm_obj);
Compression::Compressor_var compressor =
    cm->get_compressor (Compression::COMPRESSORID_ZLIB, 9);

CORBA::ULong const max_length = 65000;
Compression::Buffer source;
source.length(max_length);
for (CORBA::ULong i = 0; i < max_length; i++)
    source[i] = (CORBA::Octet)'A';

Compression::Buffer compressed;
Compression::Buffer uncompressed;

cout << "[Tester] source sequence length = " << source.length() << endl;
compressor->compress(source, compressed);
cout << "[Tester] compressed sequence length = " << compressed.length() <<
endl;
compressor->decompress(compressed, uncompressed);
cout << "[Tester] uncompressed sequence length = " << uncompressed.length() <<
endl;
```

## 7.4 ZIOP Protocol

ZIOP Protocol is a mechanism which in some particular circumstances applies compression to a GIOP message.

### 7.4.1 ZIOP Messages

A ZIOP message is a GIOP message which has set the value TRUE for the ZIOP bit at Flags field of the GIOP Header and contains compressed application data. This ZIOP bit must be selected and reserved by OMG between the third and eighth bit of Flags field of the GIOP 1.2 Header. Bit 0/1/2 are already used by the existing CORBA specification. The ServiceContext list can't be used to transfer that a GIOP message contains compressed data because a GIOP fragment doesn't contain a ServiceContext list.

GIOP compression will be only applied to send or receive the following GIOP 1.2 or later messages: GIOPRequest and GIOPReply and includes fragmented messages.

A ZIOP message defines how the application data of the GIOP Messages is compressed: when the ZIOP bit is TRUE then the GIOPRequestBody or GIOPReplyBody is replaced by the CompressionData structure, which contains the according RequestBody or ReplyBody compressed, and which is marshaled into the CDR encapsulation of the containing message immediately following the GIOP Request/Reply Header. By marshaling only the application data an ORB implementation could compress the application data only once when sending it to multiple servers.

```
// PIDL: ZIOP Request/Reply bodies in ZIOP Message  
module ZIOP {  
    struct CompressionData {  
        Compression::CompressorId compressor;  
        unsigned long original_length;  
        Compression::Buffer data;  
    };  
};
```

To allow interoperability between a ZIOP and a non ZIOP party the client ORB that supports ZIOP will send only ZIOP messages to servers which have been declared to accept ZIOP messages.

At message level, the sequence of message exchange is as follows:

- 1 - When client and server ORB support a compatible compression algorithm and if the message fulfills the compression policies (for example message size threshold) the message is compressed and the ZIOP bit in the header is set to TRUE.
- 2- The server ORB, reads the ZIOP bit at GIOP header and read the compressed GIOP Request and uncompress the GIOPRequestBody.
- 3- In the server side, if the GIOPReply message fulfills the compression policies, a compressor object is retrieved and server ORB will generate a compressed GIOP Reply and will sent it to client where the ZIOP bit in the GIOP header is set to TRUE.
- 4- The client ORB side will read the ZIOP bit at GIOP header message and then will continue reading the compressed GIOP Reply and uncompressing the GIOPReplyBody.

Both client and server only send ZIOP messages when it knows that the remote ORB supports ZIOP and it has a compatible compressor implementation, as is described in the following section.

### 7.4.2 ZIOP Message use

Client and server ORBs interchange available compression details through a set of new ZIOP CORBA Policies. These policies must be propagated as standards CORBA Policies in a ServiceContext into a GIOP Request and GIOP Reply messages.

They may also be propagated into an IOR by using the Messaging propagation of QoS. Policies which values are transferred to the remote ORB are called 'client-exposed' policies. The Messaging propagation mechanism is described in detail in section 22.3 of the CORBA 3.0.3 specification.

ORB server side applications may set available compression algorithms via appointing ZIOP Policies list to the POA that will create object references which embed these policies into the IOR component. ORB client side could send ZIOP messages defining similar Policies using PolicyContext interfaces, at ORB, thread or reference level.

As it was described before servers and clients must be agreed in GIOP Compression policies to be used. To allow this, each party must know if the other party support GIOP Compression and its preferences about compression before send to it a ZIOP message (GIOPRequest or GIOPReply compressed messages).

The server must register the CORBA object in a POA that was created with ZIOP Policies. These ZIOP Policies will be transmitted as part of the IOR through a new profile. The client may indicate through 'set\_policies\_overrides' over the remote CORBA object reference the ZIOP Polices which it has as preferences.

The client-side ORB will decide the compatible ZIOP Policies list which the ORB must use to send a GIOPRequest to the server. For this, the client-side ORB will extract the compression server preferences (ZIOP Policies) from a TaggedComponent of an IOR if it is present. The client will select a compression algorithm and could send the application data compressed to the server. The client-side ORB will also create a Policy list with its compression policies and send them in the Request as a Messaging ServiceContext.

The server-side ORB will reply to the request taking into account the ZIOP Policies that it found in the ServiceContext of the ZIOP messaging and compare it with the ZIOP Policies of the POA object.

If server does not allow receipt of compressed GIOP Requests, then the client-side ORB should not send any GIOP compressed messages. Instead, the client-side ORB will only send the ZIOP Policies values that the client supports in Messaging ServiceContext. In a similar way a server may not respond to a client with a compressed GIOP Reply if the client does not support GIOP compression.

In this way, a client and server may decide independently if compression could be used or not. There is no necessity to exchange CORBA messages between client and server to obtain the best set of ZIOP Policies to be applied in communication to get the optimal performance.

At the moment the client changes the ZIOP Policies set, the ORB must transfer these updated policies to the server. It may transfer the policies with each invocation but an optimized ORB may decide to only transfer the changed policies when it is required.

### **7.4.3 ZIOP Compression Policies**

This module ZIOP provides all necessary elements to allow interchange of compressed GIOP messages between client and servers using mechanisms defined in Compression module. The following interfaces are the ZIOP policies.

#### **7.4.3.1 CompressionEnablingPolicy interface**

This interface represents the ZIOP policy CompressionEnablingPolicy that has a boolean attribute indicating if compression is enabled or not by the tier. Only when this policy has been set to true ZIOP may be used by the ORB. This policy is client-exposed and both client and server must have set this policy to TRUE in order to enable ZIOP.

### 7.4.3.2 CompressorIdLevelListPolicy interface

This interface represents the ZIOP policy CompressorIdLevelListPolicy. It has a list of CompressorId/CompressionLevel attributes indicating the compression algorithms with their respective levels that may be used. The CompressorIdLevelListPolicy contains a sequence of structures and this sequence is ordered by preference priority. This policy is client-exposed, the client/server will take its own sequence and search for the first CompressorId that is also supported by the other tier. For this Compressor then the lowest CompressionLevel is selected.

### 7.4.3.3 CompressionLowValuePolicy interface

This interface represents the ZIOP policy CompressionLowValuePolicy. It has an unsigned long attribute indicating the minimum size of application data that has to be sent before the ORB will consider this as a ZIOP message. This policy is not client exposed.

### 7.4.3.4 CompressionMinRatioPolicy interface

This interface represents the ZIOP policy CompressionMinRatioPolicy. It has an long attribute indicating the minimum compression ratio that must be obtained at compression time to send with a compressed GIOP message. This policy tries to prevent the sending of compressed messages with few improvements about the original size in order to not overload the server with a useless uncompression process. The ratio must be obtained with the following formula:  $100 - (\text{compressed\_length} / \text{original\_length}) * 100$ . This policy is not client exposed.

## 7.4.4 Propagation of ZIOP Compression Policies

ZIOP Compression policies are transferred using the Messaging QoS Profile Component which is defined in section 22.3 of the CORBA 3.0.3 specification. This section also describes the concept of client-exposed policies.

## 7.4.5 ZIOP Usage Scenario

This section describes a client-server communication through ZIOP protocol.

### 7.4.5.1 Client

```
CORBA::ORB_ptr orb = CORBA::ORB_init (argc, argv);

CORBA::Boolean compression_enabling = true;
Compression::CompressorId compressor_id = Compression::COMPRESSORID_ZLIB;
Compression::CompressorIdLevelList compressor_id_list(1);
compressor_list.length(1);
compressor_list[0].compressor_id = compressor_id;
compressor_list[0].level = 9
CORBA::ULong compression_low_value = 32000;
Compression::CompressionRatio compression_min_ratio = 30;

CORBA::Any enabling_any, compressors_any, low_value_any, min_ratio_any;

enabling_any    <<= CORBA::Any::from_boolean(compression_enabling);
compressors_any <<= compressor_list;
low_value_any  <<= compression_low_value;
min_ratio_any  <<= compression_min_ratio;

CORBA::PolicyList policies(4);
```

```

policies.length(4);

try {
    policies[0] = orb->create_policy(ZIOP::COMPRESSION_ENABLING_POLICY_ID,
                                     enabling_any);
    policies[1] = orb->create_policy(ZIOP::COMPRESSOR_ID_LEVEL_LIST_POLICY_ID,
                                     compressors_any);
    policies[2] = orb->create_policy(ZIOP::COMPRESSION_LOW_VALUE_POLICY_ID,
                                     low_value_any);
    policies[3] = orb->create_policy(ZIOP::COMPRESSION_MIN_RATIO_POLICY_ID,
                                     min_ratio_any);
} catch(const CORBA::PolicyError&) {
    policies.length(0);
}

CORBA::Object_var obj = orb->string_to_object(uri);
CORBA::Object_var obj2 = CORBA::Object::_nil();

try{
    obj2 = obj->_set_policy_overrides(policies, CORBA::ADD_OVERRIDE);
} catch(const CORBA::SystemException&) {
    obj2 = obj;
}

Echo::Test_var test_ref = Echo::Test::_narrow(obj.in ());
Echo::Test_var ziop_test_ref = Echo::Test::_narrow(obj2.in ());
CORBA::String_var str = test_ref->echo(message);
CORBA::String_var str = ziop_test_ref->echo(message);

```

#### 7.4.5.2 Server

```

CORBA::ORB_var orb = CORBA::ORB_init (argc, argv);

CORBA::Object_var poaobj = orb->resolve_initial_references ("RootPOA");
PortableServer::POA_var poa = PortableServer::POA::_narrow (poaobj);
PortableServer::POAManager_var mgr = poa->the_POAManager();

CORBA::Boolean compression_enabling = true;
Compression::CompressorId compressor_id = Compression::COMPRESSORID_ZLIB;
Compression::CompressorIdLevelList compressor_id_list(1);
compressor_list.length(1);
compressor_list[0].id = compressor_id;
compressor_list[0].level = 5;
CORBA::ULong compression_low_value = 16384;
Compression::CompressionRatio min_compression_ratio = 40;

CORBA::Any enabling_any, compressors_any, low_value_any, min_ratio_any;

enabling_any    <<= CORBA::Any::from_boolean(compression_enabling);
compressors_any <<= compressor_list;
low_value_any   <<= low_value;
min_ratio_any   <<= min_ratio;

```

```

PortableServer::POA_var my_compress_poa = PortableServer::POA::_nil();

CORBA::PolicyList policies(4);
policies.length(4);

try {
    policies[0] = orb->create_policy(ZIOP::COMPRESSION_ENABLING_POLICY_ID,
                                   compression_enabling_any);
    policies[1] = orb->create_policy(ZIOP::COMPRESSOR_ID_LEVEL_LIST_POLICY_ID,
                                   compressors_any);
    policies[2] = orb->create_policy(ZIOP::COMPRESSION_LOW_VALUE_POLICY_ID,
                                   low_value_any);
    policies[3] = orb->create_policy(ZIOP::MIN_COMPRESSION_RATIO_POLICY_ID,
                                   min_ratio_any);
    my_compress_poa = poa->create_POA("My_Compress_Poa",
                                     PortableServer::POA::_nil (), policies);
} catch(const CORBA::PolicyError&) {
    policies.length(0);
    my_compress_poa = poa->create_POA("My_Compress_Poa",
                                     PortableServer::POA::_nil (), policies);
}

PortableServer::POAManager_var my_compress_poa_mgr =
    my_compress_poa->the_POAManager();

my_compress_poa_mgr->activate();

PortableServer::ObjectId_var oid = my_compress_poa->activate_object (servant);

CORBA::Object_var ref = poa->id_to_reference (oid.in ());

```

## 7.5 ZIOP Compression VS SSL/TLS Compression

The CORBA specification defines in the Secure Interoperability section the use of SSL/TLS. The specification for SSL/TLS again defines the use of compression in this layer of the protocol. Therefore it is an option to use SSL/TLS without any encryption but with a compression, instead of implementing ZIOP compression. On the other hand, there is the flexibility and functionality using ZIOP compression:

- ZIOP compression is usable on a per message base and not like with SSL/TLS on a per session base compression. The ORB may decide to compress one GIOP fragment and not to compress another fragment of the same GIOP request.
- ZIOP gives freedom to the compression algorithm selection. The SSL/TSL specification defines just one compression algorithm. It has the possibility to add further algorithms but if and what other algorithms can be used is vendor specific and in the most SSL/TSL implementations only one compression algorithm is included.
- ZIOP compression includes a message size and compression ratio threshold under which no compression will be used. SSL/TSL compress every message independent of their size, this can lead under certain circumstances to negative effect on the message size.
- ZIOP compression has the possibility to realize a one-way compression in any server-client or client-server direction by using the highest value for the message size threshold. In that case no outgoing message will be compressed but the sender is

still capable of receiving compressed incoming messages. For instance, this might be useful if one side sends big data messages and the other side just receipt the received data as validation. This type of one-way compression is only possible on per message base compression with a message size threshold and therefore it is impossible to realize this with the SSL/TSL compression.

## Annex A

### Compression IDL

```
#pragma prefix "omg.org"
module Compression {
    exception CompressionException {
        unsigned long reason;
    };
    exception FactoryAlreadyRegistered { };
    exception UnknownCompressorId { };

    typedef unsigned short CompressorId { };
    const CompressorId COMPRESSORID_NONE = 0;
    const CompressorId COMPRESSORID_GZIP = 1;
    const CompressorId COMPRESSORID_PKZIP = 2;
    const CompressorId COMPRESSORID_BZIP2 = 3;
    const CompressorId COMPRESSORID_ZLIB = 4;
    const CompressorId COMPRESSORID_LZMA = 5;
    const CompressorId COMPRESSORID_LZO = 6;
    const CompressorId COMPRESSORID_RZIP = 7;
    const CompressorId COMPRESSORID_7X = 8;
    const CompressorId COMPRESSORID_XAR = 9;

    typedef unsigned long CompressionLevel;
    typedef long CompressionRatio;

    struct CompressorIdLevel {
        CompressorId compressor_id;
        CompressionLevel compression_level;
    }
    typedef sequence <CompressorIdLevel> CompressorIdLevelList;

    typedef CORBA::OctetSeq Buffer;

    local interface Compressor {
        void compress(
            in Buffer source,
            inout Buffer target)
            raises (CompressionException);
        void decompress(
            in Buffer source,
            inout Buffer target)
            raises (CompressionException);
        readonly attribute CompressorFactory compressor_factory;
        readonly attribute CompressionLevel compression_level;
        readonly attribute unsigned long long compressed_bytes;
        readonly attribute unsigned long long uncompressed_bytes;
    };
};
```

```

    readonly attribute CompressionRatio compression_ratio;
};

local interface CompressorFactory {
    readonly attribute CompressorId compressor_id;

    Compressor get_compressor(in CompressionLevel compression_level);
};

typedef sequence<CompressorFactory> CompressorFactorySeq;
local interface CompressionManager {
    void register_factory(
        in CompressorFactory compressor_factory)
        raises (FactoryAlreadyRegistered);
    void unregister_factory(
        in CompressorId compressor_id)
        raises (UnknownCompressorId);
    CompressorFactory get_factory(
        in CompressorId compressor_id)
        raises (UnknownCompressorId);
    Compressor get_compressor(
        in CompressorId compressor_id,
        in CompressionLevel compression_level)
        raises (UnknownCompressorId);
    CompressorFactorySeq get_factories();
};
};

```

## Annex B

### ZIOP IDL

```
module ZIOP {
    struct CompressedData {
        Compression::CompressorId compressorId;
        unsigned long original_length;
        Compression::Buffer data;
    };

    typedef boolean CompressionEnablingPolicyValue;

    const CORBA::PolicyType COMPRESSION_ENABLING_POLICY_ID = "TBD by OMG";

    local interface CompressionEnablingPolicy: CORBA::Policy
    {
        readonly attribute CompressionEnablingPolicyValue compression_enabled;
    };

    const CORBA::PolicyType COMPRESSOR_ID_LEVEL_LIST_POLICY_ID = "TBD by OMG";

    local interface CompressorIdLevelListPolicy: CORBA::Policy
    {
        readonly attribute Compression::CompressorIdLevelList compressors;
    };

    typedef unsigned long CompressionLowValuePolicyValue;

    const CORBA::PolicyType COMPRESSION_LOW_VALUE_POLICY_ID = "TBD by OMG";

    local interface CompressionLowValuePolicy: CORBA::Policy
    {
        readonly attribute CompressionLowValuePolicyValue low_value;
    };

    const CORBA::PolicyType COMPRESSION_MIN_RATIO_POLICY_ID = "TBD by OMG";

    local interface CompressionMinRatioPolicy: CORBA::Policy
    {
        readonly attribute Compression::CompressionRatio ratio;
    };
};
```