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ANSA Phase III

DIMMA WORKSHOP - CORBA Personality (JET)

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Abstract

This presentation covers the CORBA Personality work as at November 1996.

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Briefing Note

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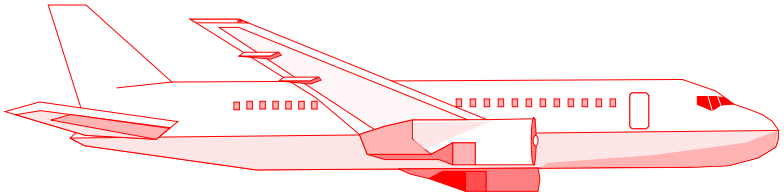
DIMMA WORKSHOP

CORBA Personality (JET)



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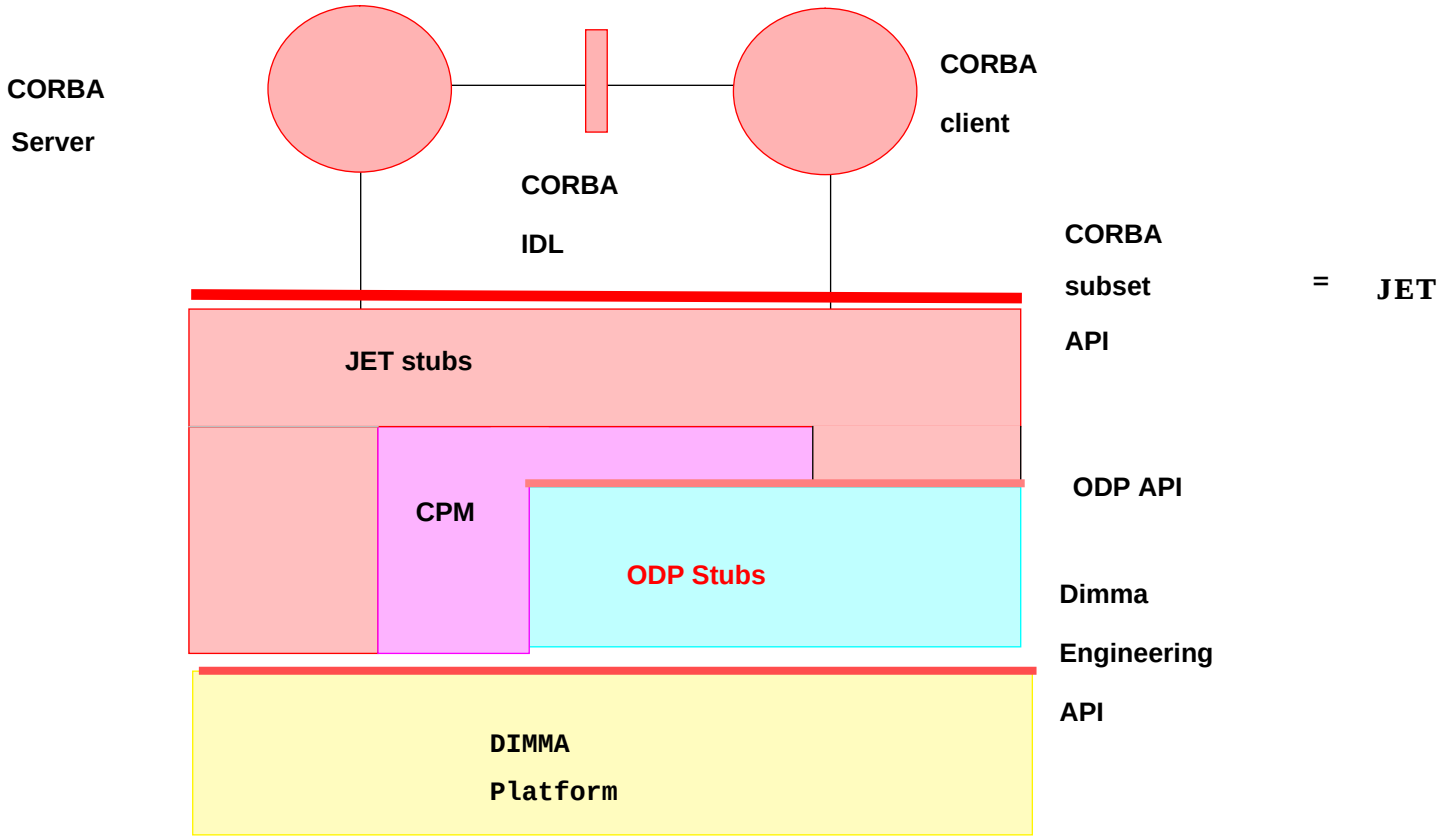
Agenda

- How Jet fits into DIMMA
- Jet = CORBA - an extended subset?
- Jet components
- A Simple Example
- Building a Jet application
- Advanced Jet

How JET works - CORBA and the ODP API



Jet = CORBA - an extended subset?

- not included
  - context parameter
  - oneway invocations - but are provided by streams
  - BOA object adapter
  - concrete any
  - dumb pointers T* - impinges on memory management
- in this release - CORBA::Object, arrays, unions
- maybe included in future releases
  - attributes
  - CORBA::Object
  - arrays, unions

Memory Management - T_var v. T*

- A CORBA API can be implemented using either T_var or T*
- you can do everything with one or the other
- you don’t need both

- T_var uses smart pointers with a reference count
- easy to implement garbage collection

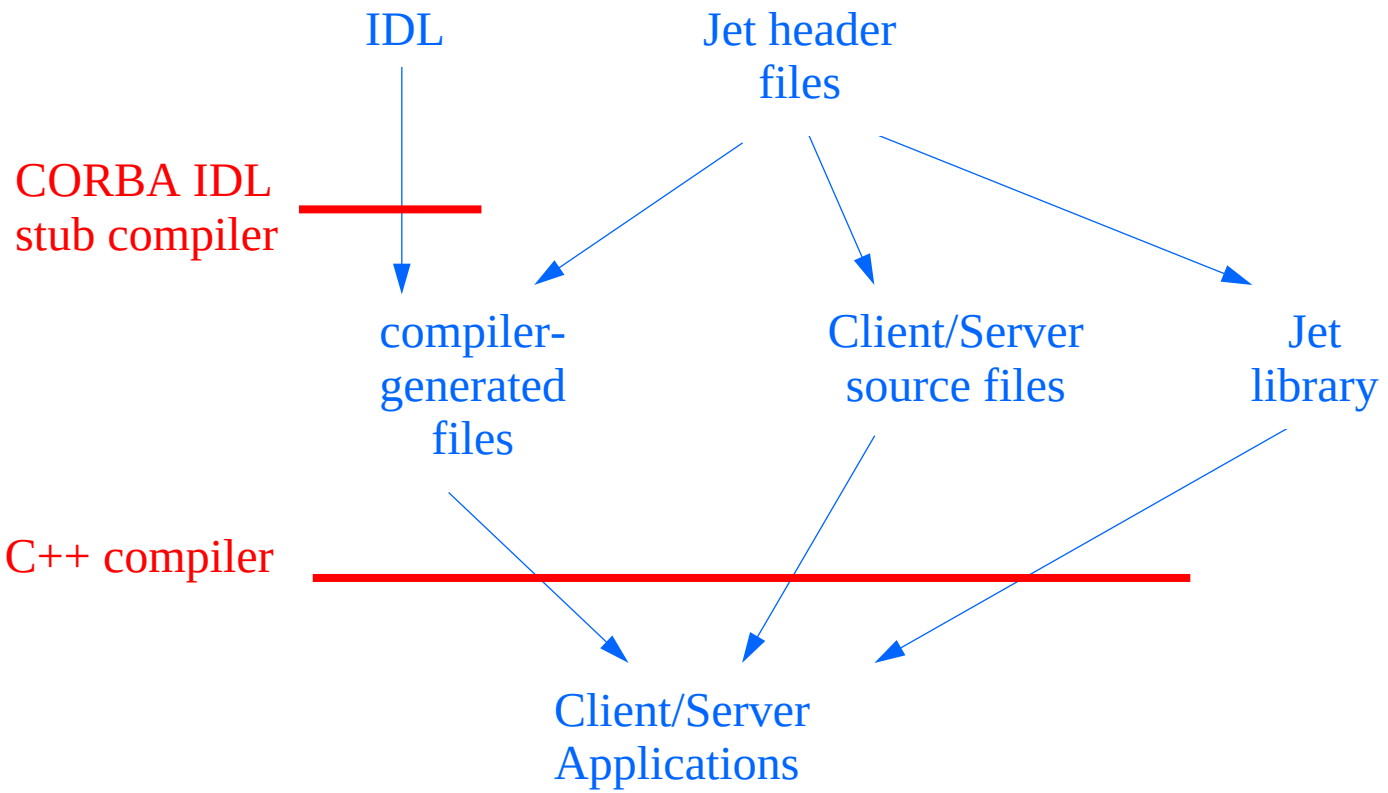
- T* needs release/duplicate
- garbage collection harder

- support is provided for T_var only

Major Features

- support for simple types, structures, sequences and interfaces
- invocations (with in/inout/out)
- top level marshalling (underlying marshalling done in ODP API)
- _bind (trader import for client)
- exceptions

Jet Components



Header Files - 1

- corba.hh - definition of CORBA class
  - standard type definitions (e.g. CORBA::Long)
  - methods within the CORBA namespace (e.g. CORBA::string_alloc(CORBA::ULong n))
- corba_exceptions.hh
  - base class for all exceptions
  - base class for all system exceptions
  - base class for all user exceptions
  - definitions of system exceptions

Header Files - 2

- corba_structured.hh - class definitions and templates for:
  - String_var
  - struct_var
  - sequences
  - sequence_vars
- jet.hh
  - Jet class - the Jet personality module (as opposed to CORBA)

Jet Library

- part of the interface between CORBA and ODP
- maps ODP system exceptions onto CORBA system exceptions
- provides methods used for trading

CORBA IDL Compiler

- **Uses SunSoft's implementation of the compiler front end for OMG Interface Definition Language. This consists of:**
  - **main program for driving the compilation process**
  - **parser and attendant utilities**
  - **back end for taking in the processed input and producing output as required**
- **Modifications to SunSoft's implementation consist of:**
  - **changes to the parser for streams**
  - **the back end to generate Jet internals and stubs appropriate for ODP**

Files Generated - 1

- for a given idl, e.g. echo.idl:
- echo.hh - defines the class for each interface. This includes:
  - interface declarations
  - operation declarations
  - declarations for Jet internals
  - _bind declaration
- echo_Server.hh contains:
  - application programmer extendable EchoObject class which contains the Echo interface
  - application programmer extendable Echo INTERFACE class - ties the Echo i/f with its originating object
- echo_i.hh contains:
  - factory class for generating a new instantiation of the object
  - the _export method for the object
  - method templates for each operation

Files Generated - 2

- **echo_C.cc - client stubs and associated methods**
- **echo_M.cc - any IDL specific marshalling (e.g. for structures)**
- **echo_N.cc - the dispatch table, used by the server to identify operations**
- **echo_S.cc - server stubs and associated methods**
- **echo_Srv_Main.cc - a typical main program - can be used directly or replaced by a user-defined version.**
  - creates a single Echo object
  - exports the object reference to the trader
  - invokes capsule_ready() to put the server into a state where it is awaiting invocations
- **echo_orbC.cc - import and bind methods for the client**

Jet Internals - Server

Object_factory

- Echo_i EchoObject_factory() { return (new EchoObject()->body(); }
  // creates an EchoObject object - normally invoked from main program (Echo_Srv_Main.cc)
- Echo_i* EchoObject::body() { return new Echo_i(this); }
  // creates an Echo interface

_export

- converts interface reference to odp_Any (used as generic interface reference) and passes it as an argument to the trader->export() method

Jet Internals - Client

_bind

- the _bind function builds a set of trader properties based on the interface name, and passes this to the Echo_import function
- Echo_import invokes the _import method on the trader to obtain the required interface reference, which can subsequently be used for invoking operations

Server Stubs

- Dispatcher uses switch statement to execute code specific to required operation
- Declarations are made for all arguments
- In and Inout arguments are unmarshalled
  - any exceptions are dealt with
- The invocation is made
- The results are unmarshalled
- Any locally allocated memory is deleted
- Any exceptions are dealt with

Client Stubs

- The Client stub is invoked directly from the Client
- In and Inout arguments are marshalled
- The operation is invoked
- The stub executes a switch on the response from the invocation:
  - 0 - successful response
  - 1 - system exception
  - >1 - user exceptions
- The results (or exceptions) are unmarshalled and returned to the Client
- Any exceptions occurring within the client stub are dealt with

A Simple Example

```
interface Echo                                          // echo.idl
{
  unsigned long Echo_1(in short mysh, out long mylng,
        inout float myfl );
};

#include “echo_i.hh”                                    // echo_i.cc

CORBA::ULong
Echo_i:: Echo_1
(
    CORBA::Short src,
    CORBA::Long& resL,
    CORBA::Float& resF
)
{
  resL = src;
  resF = src;
  return src;
}
```

```
#include “iostream.h”                                    // Client.cc
#include “echo.hh”

main()
{
  Echo_var evar = Echo::_bind(“:IntSrv”);
  CORBA::Short aSh;
  CORBA::Long aL;
  CORBA::ULong auL;
  CORBA::Float aF;

  aSh = 100;
  auL = evar->Echo_1(aSh, aL, aF);
  cout << auL << “ ” << aL << “ ” << aF << endl;

}
```

```
class Echo;                                                    // echo.hh
typedef odp_InvocationRef<Echo> Echo_var;
extern Echo_var Echo_var_client (odp_Reference * ref) ;
extern void operator <<= (odp_Any&, const Echo_var&);
extern Boolean operator >>= (const odp_Any&, Echo_var&);

class Echo : public odp_Signature {
public:
  virtual CORBA::ULong Echo_1 (
    CORBA::Short mysh,
    CORBA::Long &mylng,
    CORBA::Float &myfl) = 0 ;

  static const char * const odp_names [] ;

  static odp_InvocationRef<Echo> _bind(
    const char* IT_markerServer = "",
    const char* host = "");

  static Echo_var _duplicate( Echo_var ref )
    { ref->odp_increfs(); return ref; };
} ;
```

```
/
/* echo_Srv_Main.cc */

#include <echo_Server.hh>

extern void capsule_ready(void);

int main( int argc, char **argv)
{
  Echo_var myEcho = EchoObject_factory(); // create Echo object

  if (EchoObject::_export(myEcho, (const char*) “/DIMMA”) == -1)
{
    cout << “failed to export Echo interface” << endl; exit(1); }

#ifdef ODP_DON
       capsule_ready(); // required for the single threaded case.
#endif
         return 0 ;
}
```

```
odp_Transmitter &                              // echo_S.cc - extract
  odp_Dispatcher<Echo_var>::dispatch(odp_Receiver*b)
  throw (){
  switch (_request(b)) {
  case 1: {
    CORBA::Short a1;
    CORBA::Long r2;
    CORBA::Float i1;
    try {
      *b >> a1 >> i1 ;
    } catch (odp_Termination& t) {
      //failed to de-marshall arguments
      return response( b, 1 ) << Jet::asException(t);
    }
    try {
      CORBA::ULong r1 = ir->Echo_1( a1, r2, i1 );
      odp_Transmitter &x = response(b) << r1
        << r2
        << i1;
      return x;
    }
    // deal with exceptions here
```

```
CORBA::ULong odp_Echo_Client::Echo_1 (    // echo_C.cc - extract
  CORBA::Short a1,
  CORBA::Long &r2,
  CORBA::Float &i1 ) {
    try {
      odp_Transmitter *const out = request(1) ;
      *((odp_Transmitter *)out)
         << a1
         << i1 ;
      const odp_Releaser in = invoke( out ) ;
      switch ( _response( *in ) ) {
        case 0: {
          CORBA::ULong r1;
          *in >> r1 >> r2 >> i1;
          return r1 ;
        } break;
        case 1: {
          CORBA::SystemException se;
          *in >> se;
          throw se;
        } break; } }
// handle exceptions here
```

```
// echo_orbC.cc - extracts
Echo_var Echo_import(char *type, char *ctxt, char *prop)
{
  Echo_var objRef;
  ansa_Trader trader;
  try {
    trader = capsule_manager->ansa_trader();
  }
  catch (odp_Termination& t) {
    throw Jet::asException (t);
  }
  catch (...) {
    throw CORBA::UNKNOWN ();
  }

  if (!(trader->import(type, ctxt, prop) >>= objRef)) {
    throw CORBA::NO_IMPLEMENT ();
    // Cannot find implementation of interface
  }

  return ( objRef );
}
```

```
// echo_OrbC.cc contd.

Echo_var Echo::_bind( const char* IT_markerServer, const char
*host)
{
  char ctxt_name[256];
  char type_name[256];
  char prop[1024];
  strcpy( type_name, “Echo” );
  strcpy( ctxt_name, “/DIMMA” );
  strcpy( prop, “” );

  Jet::build_trader_properties(IT_markerServer, host, prop);
  return Echo_import( type_name, ctxt_name, prop );
}
```

Building a Jet Application within the DIMMA source tree

```
ROOT = echo
BINS := $(ROOT)_server $(ROOT)_client
LIBRARIES       += -ljet
ifeq ($(ODP_DPE),ansa)
        DEPS    += $(SHADOW)/lib/libodp_ansa.a
endif
ifeq ($(ODP_DPE),don)
        DEPS    += $(SHADOW)/lib/libodp_don.a
endif
IDL_OUTPUT    :=    $(ROOT).hh    $(ROOT)_orbC.cc    $(ROOT)_C.cc
$(ROOT)_S.cc $(ROOT)_N.cc
$(ROOT)_Server.hh $(ROOT)_i.hh
all: $(BINS)
CLIENT_OBJS     := $(ROOT)_orbC.o $(ROOT)_C.o $(ROOT)_N.o
$(ROOT)_client: Client.o $(CLIENT_OBJS)
SERVER_OBJS := $(ROOT)_S.o $(ROOT)_N.o
$(ROOT)_server: $(ROOT)_Srv_Main.o $(ROOT)_i.o $(SERVER_OBJS)
$(dependencies): $(IDL_OUTPUT)
$(IDL_OUTPUT): $(ROOT).idl
        cd  $(<D); \\p        $(IDL) $(<F)
```

Advanced Jet

- Sequences
- Structures
- Interface references
- Streams
- Storage

Sequences - 1

- implementation uses templates
- for an idl definition:

```
interface Echo{
typedef sequence <long> BuffType;
}
```

- echo.hh would hold:

```
typedef corba_ManagedSequence<corba_Sequence<CORBA::Long,0>,
  CORBA::Long,0> BuffType ;
typedef corba_Pointer<BuffType, CORBA::Long> BuffType_var ;
```

- three templates used:
  - **corba_Sequence** - template <class ELEMENT, int TYPE>
  - **corba_ManagedSequence** - template <class SEQUENCE, class ELEMENT, int TYPE>
  - **corba_Pointer** - template <class SEQUENCE, class ELEMENT>

Sequences - 2

- TYPE - of historic value, no longer used, will disappear in next release
- corba_Sequence - the generic sequence
- corba_ManagedSequence - inherits from SEQUENCE, also from odp_RefCounter, to enable smart pointer support
- odp_Pointer is a friend of corba_ManagedSequence, and provides the smart pointer support for sequence_vars

Sequences - 3

- additional templates are used in the implementation of sequences
  - corba_BoundedSequence - template <class ELEMENT, const CORBA::ULong MAXIMUM, int TYPE> - similar to corba_Sequence, but has a fixed maximum size.

```
interface Echo{
typedef sequence<long, 15> BuffType;
}
```

generates

```
typedef
corba_ManagedSequence<corba_BoundedSequence<CORBA::Long,
   15,0>,CORBA::Long,0> BuffType ;
typedef corba_Pointer<BuffType,CORBA::Long> BuffType_var ;
```

Sequences - 4

- Other sequence classes (templates)
  - class corba_SeqSeq - supports nested sequences
  - class corba_BoundedSeqSeq - supports nested bounded sequences
- Problems with sequences - primarily memory allocation
  - vague and ambiguous specification
  - improved specification arrived too late
  - problems only occur when sharing data between sequences
- Implementation of sequences completely revised for next release
  - TYPE has gone
  - sequences of strings handled correctly
  - memory allocation and use of _release handled correctly

Structures - 1

- Structs differ from sequences for marshalling purposes
  - sequences need to marshall a length, and that number of elements
  - structs may have any number of varied element types
- Templates cannot be used
- Specific marshalling functions must be created for each struct
- These are generated by the IDL compiler into echo_M.cc

Structures - 2

```
struct VLstruct
{
  string str;
  long l;
};

odp_Transmitter &operator<< (odp_Transmitter &buffer,
  const Echo::VLstruct &s)
{
  buffer << s.str << s.l;
  return buffer;
}

odp_Receiver &operator>> (odp_Receiver &buffer,
  Echo::VLstruct &s)
{
  buffer >> s.str >> s.l;
  return buffer;
}
```

- Similar marshalling functions generated for struct_var's

Interface References - 1

- are marshalled as odp_References - a generic interface reference

```
// idl
interface Ping {};
interface Echo {
  Ping Echo_1( in Ping a, out Ping b );
};

// server code - exception handling omitted for clarity

Ping_var a1;
odp_Reference *a1_ref;
Ping_var r2;
*b >> a1_ref;
a1 = Ping_var_client(a1_ref);
Ping_var r1 = ir->Echo_1( a1, r2 );
odp_Transmitter &x = response(b)
  << odp_Dispatcher<Ping_var>::ref(r1)
  << odp_Dispatcher<Ping_var>::ref(r2);
return x;
```

Interface References - 2

```
// client code - exception handling omitted for clarity
Ping_var odp_Echo_Client::Echo_1 (
  Ping_var a1,
  Ping_var &r2 ) {
      odp_Transmitter *const out = request(1) ;
      *((odp_Transmitter *)out)
         << a1->odp_stub()->ref() ;
      const odp_Releaser in = invoke( out ) ;
      switch ( _response( *in ) ) {

        case 0: {
          odp_Reference *r1_ref ;
          odp_Reference *r2_ref;
          *in >> r1_ref >> r2_ref;
          r2 = Ping_var_client(r2_ref);
          return Ping_var_client(r1_ref) ;
        } break;
...
```

Streams

- in the idl:
  - use stream instead of interface
  - arguments must all be in
  - function type must be void

```
stream Flow {
        void frame1( in string src, in long no);
};
```

- some minor differences in the generated code
  - different dispatch function
  - different marshalling functions used
  - server cannot return exceptions, so throws them
  - client does not attempt to catch exceptions

Storage of Data within an Interface - 1

- examples/References/echo.idl:

```
interface Ping {
  long Id();
};
interface Echo { // returns different instances of Ping
  Ping Echo_1(out Ping p);
};
interface Bounce {
  void Bounce_1(out long l1, out long l2, in Ping p1,
     inout Ping p2);
};
```

- modifications to echo_Srv_Main.cc - default main program
  - includes “echoStore.hh” instead of “echo_Server.hh” (more later)
  - normally creates a single instance of each interface and exports this to the trader
  - here we only want to create instances of Echo and Bounce - Ping is created only on request - creation of Ping in echo_Srv_Main is removed

Storage of Data within an Interface - 2

- echoStore.hh
  - includes echo_Server.hh, which defines xObject, x_i classes for each interface
  - defines classes PingStore (inherits from PingObject)
    PingImpl (inherits from Ping_i)
    EchoStore (inherits from EchoObject)
  - these classes may include data and additional methods
- echo_i.cc (user written server)
  - defines PingOBJIMPL and PingINTFIMPL as PingStore and PingImpl respectively, prior to including echo_i.hh
- echo_i.hh
  - defines xOBJIMPL and xINTFIMPL to be xObject and x_i for each interface, provided these are not already defined
  - here they are already defined for Ping, so PingObject_factory will create an instance of the PingStore object and PingImpl interface, rather than PingObject and Ping_i classes

Storage of Data within an Interface - 3

- complications due to possibility of odp objects having multiple interfaces, while in CORBA the object and the interface is virtually indistinguishable
- for Ping, we now have an object PingStore, and an interface PingImpl
- in the References example:
  - PingStore has data: CORBA::Long id
  - PingImpl has a method factorySettings by which id can be initialised
- We can now write our server methods - the idl was:

```
interface Ping {
     long Id();
   };
   interface Echo { // returns different instances of Ping
     Ping Echo_1(out Ping p);
   };
   interface Bounce {
     void Bounce_1(out long l1, out long l2, in Ping p1,
        inout Ping p2); };
```

Storage of Data within an Interface - 4

- class Ping_i has a method which returns the value of id

```
CORBA::Long
Ping_i:: Id ()
{
  return ((PingStore*) object)->id;
}
```

- The id is stored in the PingStore object, so must be retrieved from there

Storage of Data within an Interface - 5

- class Echo_i has a method which returns two different Ping_var's, each with a different id

```
Ping_var Echo_i:: Echo_1 (Ping_var& p) {
  PingImpl* obj1 = (PingImpl*)PingObject_factory();
  obj1->factorySettings(5);
  PingImpl* obj2 = (PingImpl*)PingObject_factory();
  obj2->factorySettings(10);
  p = obj2;
  return obj1;
}
```

- the PingObject_factory (which creates PingStore/PingImpl classes) is invoked to create a new Ping instance, and the factorySettings method invoked to set the id. The factorySettings method in the PingImpl class is specified as:

```
void factorySettings (int val)
              { ((PingStore*)object)->id = val; }
```

Summary

- Overview of current release
- CORBA component of future releases
  - upgraded support for sequences
  - support for CORBA::Object for passing around generic interface references
  - a simpler method for storing and accessing data
  - What else?