Poseidon House
Castle Park
Cambridge CB3 0RD
United Kingdom

TELEPHONE: **Cambridge (01223) 515010**
INTERNATIONAL: **+44 1223 515010**
FAX: **+44 1223 359779**
E-MAIL: **apm@ansa.co.uk**

Training

ANSAwise - Specifying Services in CORBA IDL

Chris Mayers

Abstract

CORBA specifies an interface definition language (IDL) as the basis of a ‘contract’ between client and server.

This module of the ANSAwise training programme gives an overview of CORBA IDL and points out some of its pitfalls. This module also shows a few fragments of the C++ Language Mapping to show how IDL is used in a typical build processs

[This module is a variant of APM.1348. This module covers only CORBA IDL, and does not relate iit to DCE IDL or ANSAware IDL.]

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Briefing Note

Distribution:
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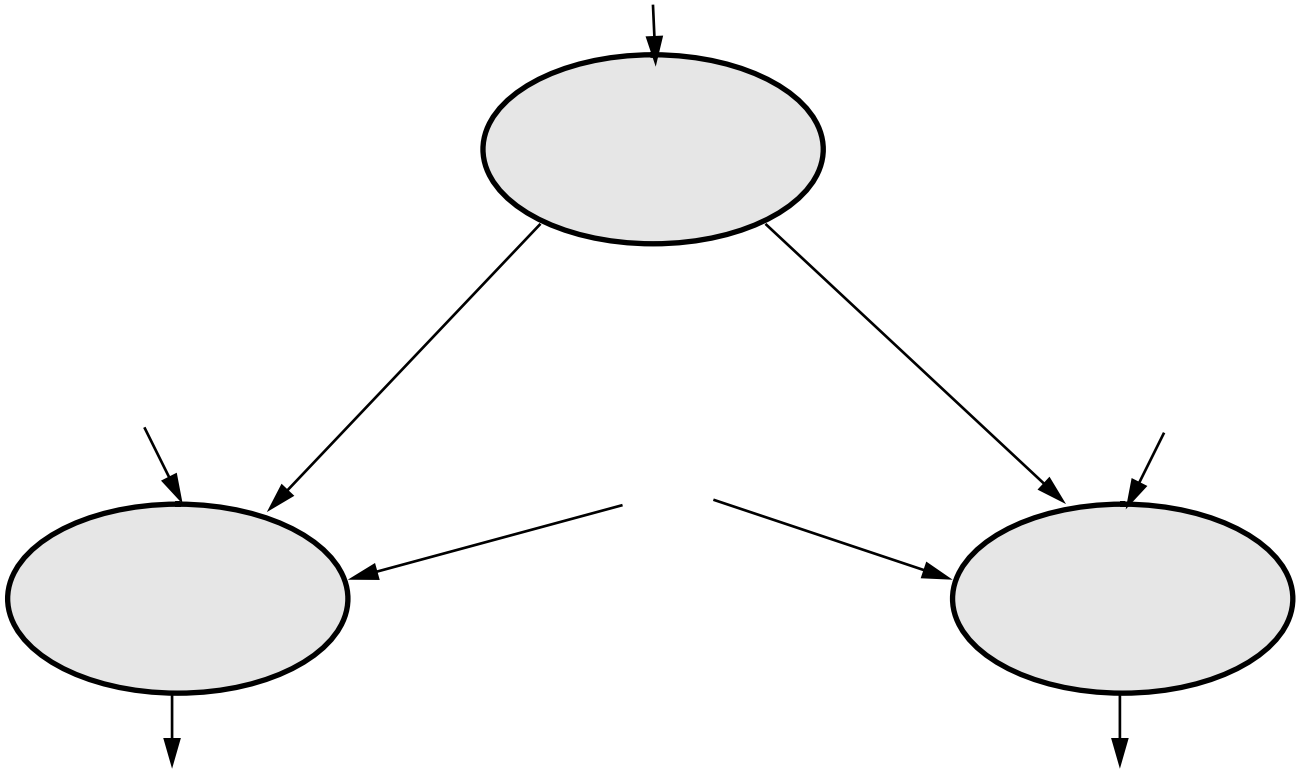
Specifying Services in CORBA IDL



In this session

- **Explain the purpose of interface definitions**
- **Explain how to write service specifications in CORBA IDL (Interface Definition Language)**
- **Explore the basic constructs of CORBA IDL**

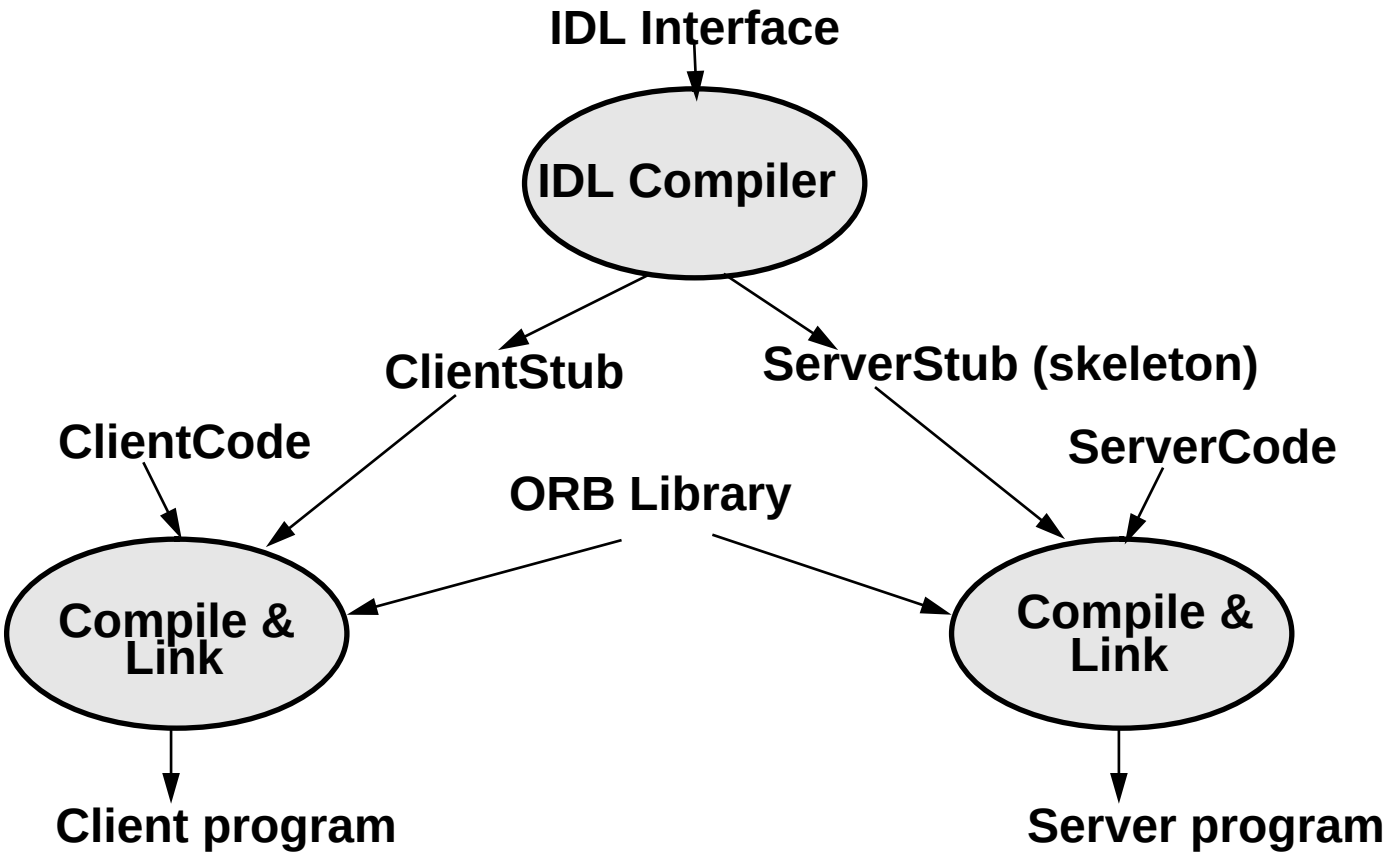
Interface Definitions

- **Interface Definitions are a ‘contract’ between service provider and service user**
  - **client and server (object implementation)**
- **Each side of the interface abides by the contract**
- **A complete contract would define the interface’s**
  - **type**
  - **behaviour**
  - **characteristics (for example, quality-of-service)**
- **CORBA IDL intentionally only defines interface types**

CORBA Interface Definitions

- **Contain only definitions and declarations**
  - **no statements**
  - **...they cannot be executed**
  - **... they are 'sophisticated header files'**
  - **... they *are* compiled**
- **Support many programming languages (C, C++, Smalltalk, Ada,...) from one interface definition**
  - **any programming language for which there is a *language mapping***

CORBA IDL in a simple build process



CORBA applications and interfaces

- **One CORBA application can**
  - **use many IDL interfaces (as a client)**
  - **implement many IDL interfaces (as a server - an *object implementation*)**
- **One CORBA interface can**
  - **be used by many applications**
  - **be implemented by many applications**

A simple service in CORBA IDL

- This looks rather like C++

```
interface Echo {
// Comment lines start with two slashes

     string Echo (in string Src);

     string Reverse (in string Src);

};
```


Example C++ Interface Mapping

- This mapping is typical

```
class Echo;
typedef Echo *Echo_ptr;
typedef Echo_ptr Echoref;
class A : public virtual Object
{
  // Inherits from the C++ class Object defined by CORBA
  public:
  ...

  virtual char *Echo (const char *Src) = 0;

  virtual char *Reverse (const char *Src) = 0;
  ...
};
...
```


CORBA IDL for specification

- **CORBA IDL is close to a pure specification language**
  - **special cases are included for efficiency of language mappings**
- **... there are few arbitrary restrictions**

CORBA Modules and Interfaces

- So, an interface is a description of a set of possible operations that a client may request from an object
- Interface definitions can be grouped together into an IDL module
  - for example, to share common type definitions

```
module CORBA {
   typedef string Identifier;
   ...
   interface Contained: IRObject {
      attribute Identifier name;
   }
   ...
}
```

- Modules are not visible at run-time, only interfaces

CORBA Operations

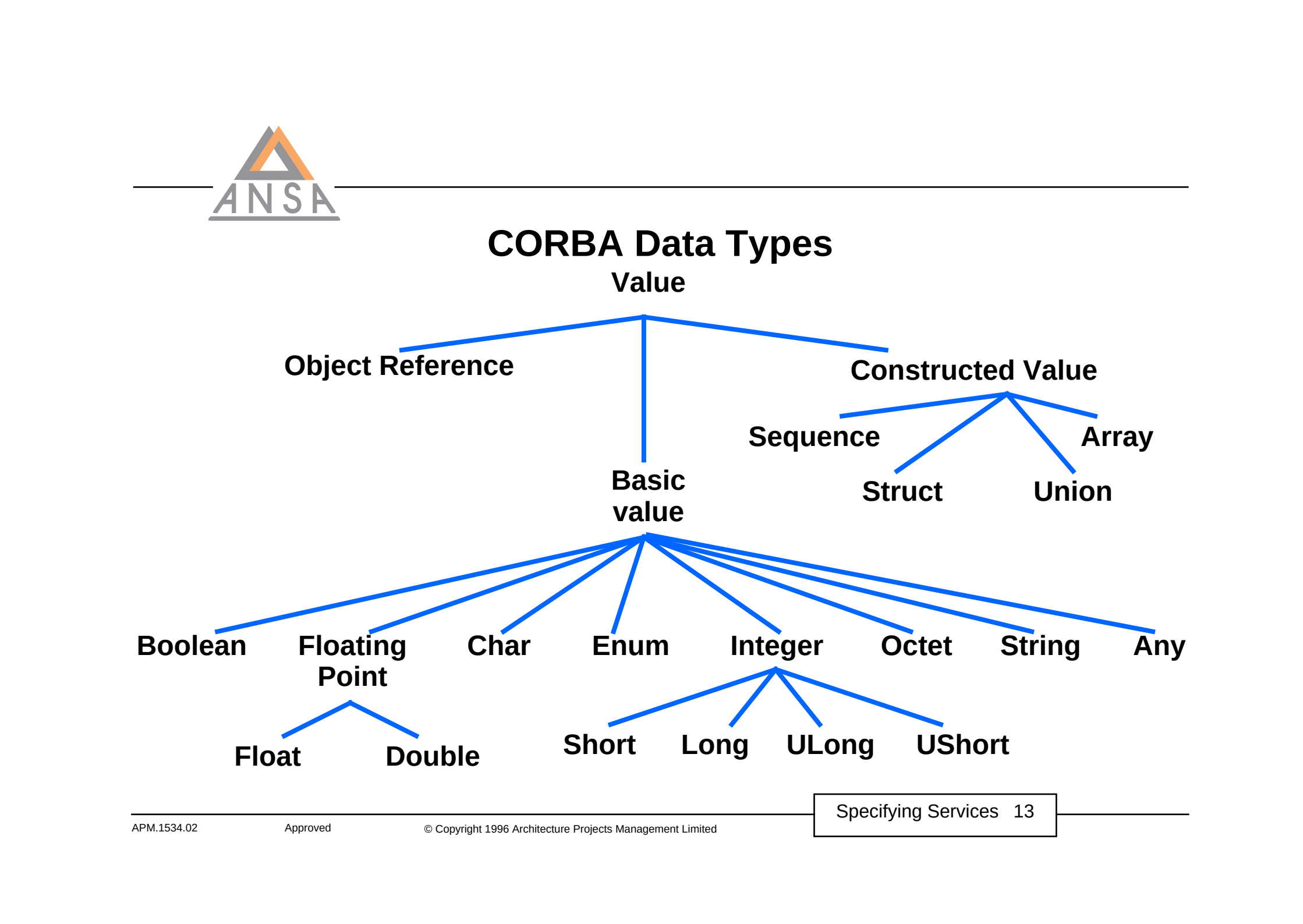
- Operations are much like function prototypes...

```
Status create_request (
   in Context        ctx,
   in Identifier     operation,
   in NVList         arg-list,
   inout NamedValue  result,
   out Request       request,
   in Flags          req_flags
);
```

- ... note the use of modes in, out, and inout
- An operation may return only a single result
  - ... this is a concession to the language mappings; most programming languages do not support multiple results

CORBA Attributes

- An interface can have attributes
- Each attribute is equivalent to a pair of accessor functions
  - a get function to read the value
  - a set function to write the value
- The value can be a basic or constructed value (e.g. a sequence)
- A read-only attribute has only the get function
- The attribute accessor functions are not the same as operations
  - they may have a more convenient language mapping



CORBA Types Have Specified Values

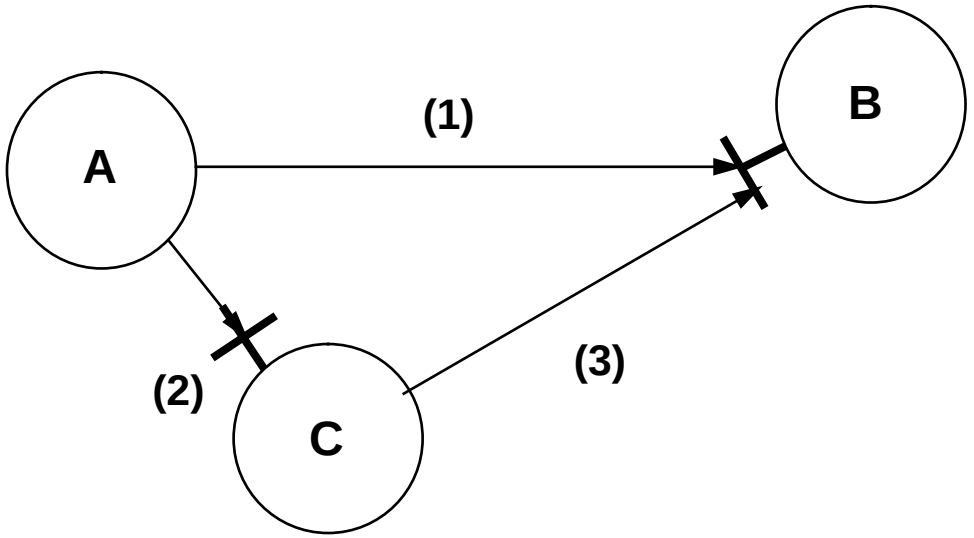
- Unlike some programming languages, CORBA types have a specified set of values
  - for example, short has exactly the range -2^{15} .. $2^{15}-1$
  - ... no more, no less
- What about 64-bit integers?
  - Sorry, no 64-bit integers yet - long is the longest: -2^{31} .. $2^{31}-1$
  - ... and there's no 8-bit integer either (although there is an octet type)

CORBA Types Do Not Have Specified Representations

- **The representation of the values is not specified**
  - **it will differ between machines (e.g byte ordering)**
  - **... the stubs resolve this (when marshalling/unmarshalling)**
  - **... the application programmer does not have to worry**

Transfer of Object References

- **In a distributed system, we need to be able to transfer object references**
  - **Object A is using Object B**
  - **Suppose it needs to tell C to use the same interface**



  - **It must be possible to pass a *reference* to B's interface between A and C**

CORBA Object References

- For an object reference, just use the name of the interface

```
interface B {
   ...
};
interface C {
   ...
   void Op (in B my_B);
   ...
};
```

  - A calls C's Op operation passing a B parameter; the implementation of C can now call operations of B

- Object references can be used freely in CORBA IDL
  - not just as parameters - also in structs, sequences, unions, arrays

CORBA Enumerations

- **Enumerations are ordered values**
  - **...for those languages that support ordered enums**
  - **...so declare them in ascending order**

```
enum boolean {FALSE, TRUE}
```

- **Enumerations can have up to 2^{32} enumerators**

CORBA Structures

- **Structures are records with fields**

- **For example**

```
struct position_t {
   float x, y;
};
```


CORBA Unions

- CORBA unions are ‘discriminated’
  - they must have an explicit typed discriminator (tag field)
  - you’ll probably want to use an enum (or perhaps boolean) for the discriminator, but you can use integer types or even char
- For example

```
union Example switch (long) {
   case 1: long x;
   case 2: float y;
   default: char z;
};
```

- Note that the discriminator has a type (here, it is long), but no name
  - language mappings give it a standard name

CORBA Sequences

- Sequences are one-dimensional, with
  - a maximum size (fixed at compile time)
  - a length (determined at run time)
- Sequences can be specified as bounded or unbounded (with or without a maximum size)
- For example, a bounded sequence of longs...

```
sequence<long,10>
```

- or an unbounded sequence of sequences

```
sequence<sequence<long> >
```


CORBA Strings

- **Strings are sequences of char**
  - **except the NUL character, of course**
- **Strings can be specified as bounded or unbounded**

  `string<10>`
  - **the bound is the maximum length...**
  - **... in some language mappings, you'll have to allocate extra storage space for a NUL terminator (11 bytes for C)**
- **Strings are not that special**
  - **they are provided because their language mappings may be more convenient and efficient**

CORBA Arrays

- **Arrays are multi-dimensional, and fixed size**
  - **indexed by integers**
  - **language mapping determines how the array indices are used (for example, 0..size-1 for C)**

The absence of pointers

- CORBA IDL deliberately does not support pointers
  - they are not meaningful in a distributed system
- Why do we normally use pointers?
  -
  -
  -
  -
  -

Sensible alternatives to pointers

- How should these pointers be described in CORBA IDL instead?
  -
  -
  -
  -
  -

Get ready to discuss this

CORBA Constants

- CORBA interfaces can declare constants of basic types
- For example

```
const long L =4;
```

- This is handy for declaring common bounds for arrays, sequences, and strings
- Constant expressions are also allowed, using C-style operators

CORBA Exceptions

- An exception is like a named ‘error status’
  - but it can have additional information...
  - ... it is like a struct
- An operation must declare which exceptions it raises
- You can declare your own exceptions

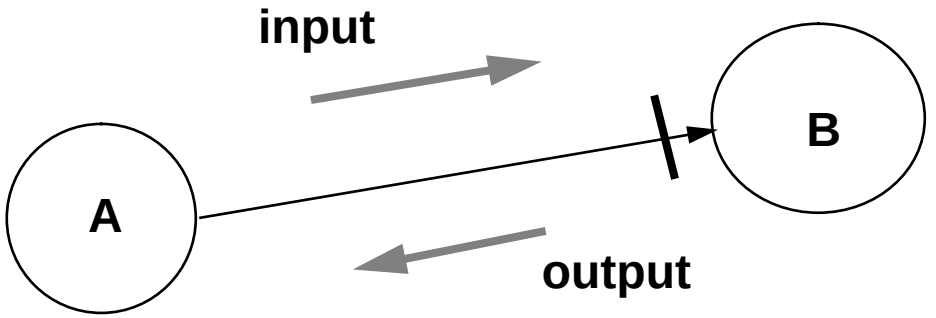
```
interface A {
      exception E {
         long L;
      };
      void f() raises(E);
};
```

CORBA standard exceptions

- There is a standard set of exceptions that can occur during any request
  - these are predefined in module StExcept
- CORBA exceptions are not necessarily implemented as programming language exceptions
  - this depends on the language mapping

Contracts Have Two Sides

- **The server (object implementation) *B* must implement the operations in its interface definition...**



- **... but the client *A* must handle all the exceptions in B's interface definition**

- **So, exceptions are the reverse side of interface definition 'contracts'**

Is IDL really necessary?

- "Why can't I just write in my ordinary programming language?"
  - if we can convert between IDLs, why not directly from C++ headers?
- One day, this may be practical
  - ...perhaps using special C++ pragmas embedded in header files
  - ...but for the foreseeable future, IDL is going to be the way to specify interfaces

General guidance for using CORBA IDL

- Use modules to collect together type definitions, constants,...
  - and to group together related interfaces
- Beware of mode inout
  - when an unbounded string or sequence is passed as an inout parameter, the returned value cannot be longer than the input value...
  - if an exception is raised, the value is undefined (it is not necessarily the input value)
- Think carefully before declaring new exceptions

Summary

- **IDL defines interfaces, not implementations**
  - **clients and servers can be implemented in any supported programming language**
- **For more on CORBA IDL**
  - **see *CORBA* (OMG)**

CORBA Pseudo Objects

- **Some special objects are implemented directly by the ORB**
  - **they have ordinary CORBA interfaces**
  - **... but are specially handled by the ORB**
  - **... these are called ‘pseudo objects’**

Inheritance in CORBA IDL

- **Inheritance in CORBA IDL is solely about extension of specifications**
  - **it is nothing to do with object implementations**
- **An interface can be derived from another interface**

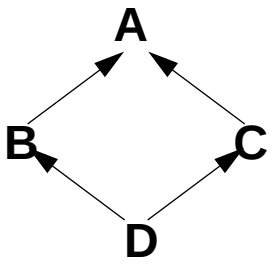
```
interface A {...};
interface B: A {...};
```

  - **here, A is the base interface of B**
  - **all the definitions of A implicitly appear in B**
- **Redefinitions are possible too**

Inheritance rules

- **Multiple inheritance is possible**

```
interface A {...};
interface B: A {...};
interface C: A {...};
interface D: B, C {...};
```



- **There are various rules to avoid strange interactions when names are redefined or names clash due to inheritance**
  - **ambiguities can be resolved by explicit qualification**

The effect of inheritance in CORBA

- Inheritance simply avoids the effort of writing down definitions a second time...

```
interface A {void f (in float x)}
interface B {long g (in long x)}
interface C: B, A {void h (in long x)}
```

- ... interface C is completely equivalent to:

```
interface C:{void f {in float x}
             long g {in long x}
             void h {in long x}}
```

- The important thing is that an object with interface C may be substituted wherever clients require A or B
  - it makes no difference which way you write down C

