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ANSA Phase III

PSO CORBA talk

Andrew Watson

Abstract

These slides were prepared for a presentation to a symposium organised by HP's PSO. The intention is to give some background on why CORBA is important (both from a technical and a marketing point of view), and to summarise its key concepts.

Planned running time is about 50 minutes.

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Request for Comments (confidential to ANSA consortium for 2 years)

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Supersedes:
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Common Object Request Broker Architecture

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APM

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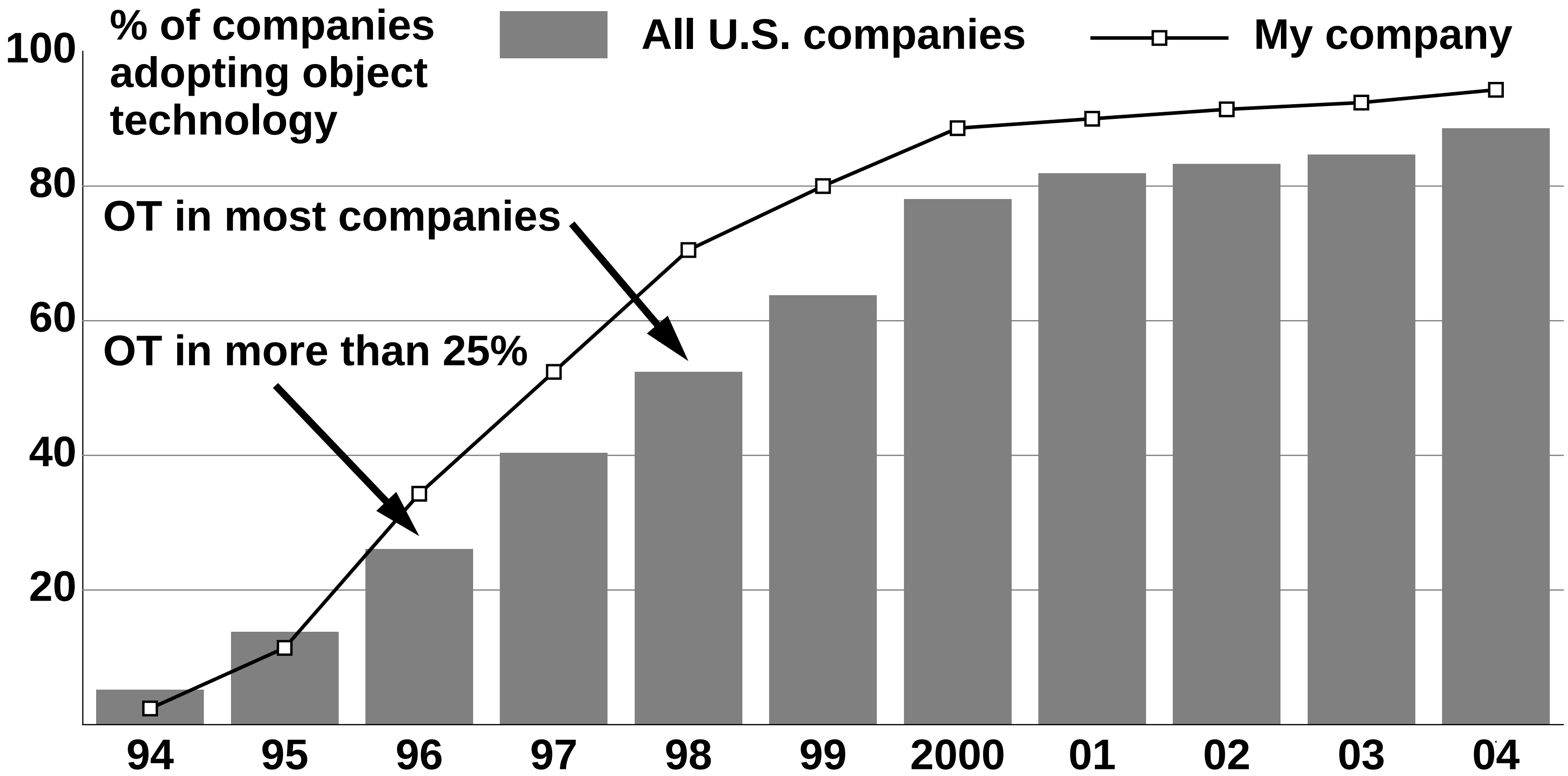
Why Objects?

- **Don't just jump on the bandwagon!**
- **There's no single agreed set of features in "an object system"**
  - **Every object-based language/database/infrastructure has a different set**
- **Key concept is encapsulation [I assert]**
  - **Precise control over how object interacts with its clients -> modularity**
  - **Modularity is the key to developing application components separately**
  - **..... to distributing application components across several machines**
  - **..... to testing and verifying components separately**
  - **..... to reusing the same components in many applications**
- **Other OO concepts (e.g. inheritance) are secondary**

Market expectations



Whence came OMG?

- **Non-profit organisation founded April 1989 to promote unified market for OO products**
  - US-based but international in scope
  - Many vendors, some end-users, one or two researchers

- **Mission: To develop a single architecture, using object technology, for distributed application integration**
  - Provides reusability of components
  - Interoperability and portability of applications
  - Based on commercially-available software
  - “It should be as easy to plug a computer into the global information network as it is to plug it into mains power network”

Org Chart

OMG Board
Chris Stone (OMG)

Technical Committee
Richard Soley (OMG)

Subcommittees

Reference Model
Mike Mathews (HP)

Policies & Procedures
Richard Soley (OMG)

Requirements
Geoff Lewis (SunSoft)

Object Model
Pat O'Brien (Object design)

Ad-hoc working group
Richard Soley (OMG)

SIGs

End-user Requirements
Pat Davis (Boeing)

OO databases
Jacob Stein (Servio)

Parallel Object systems
Gene Pierce (NCR)

Analysis & Design
Andrew Hutt (ICL))

Class Libraries
Tayloe Stansbury (Borland)

Smalltalk
Duane Bay (ParcPlace)

Task Forces

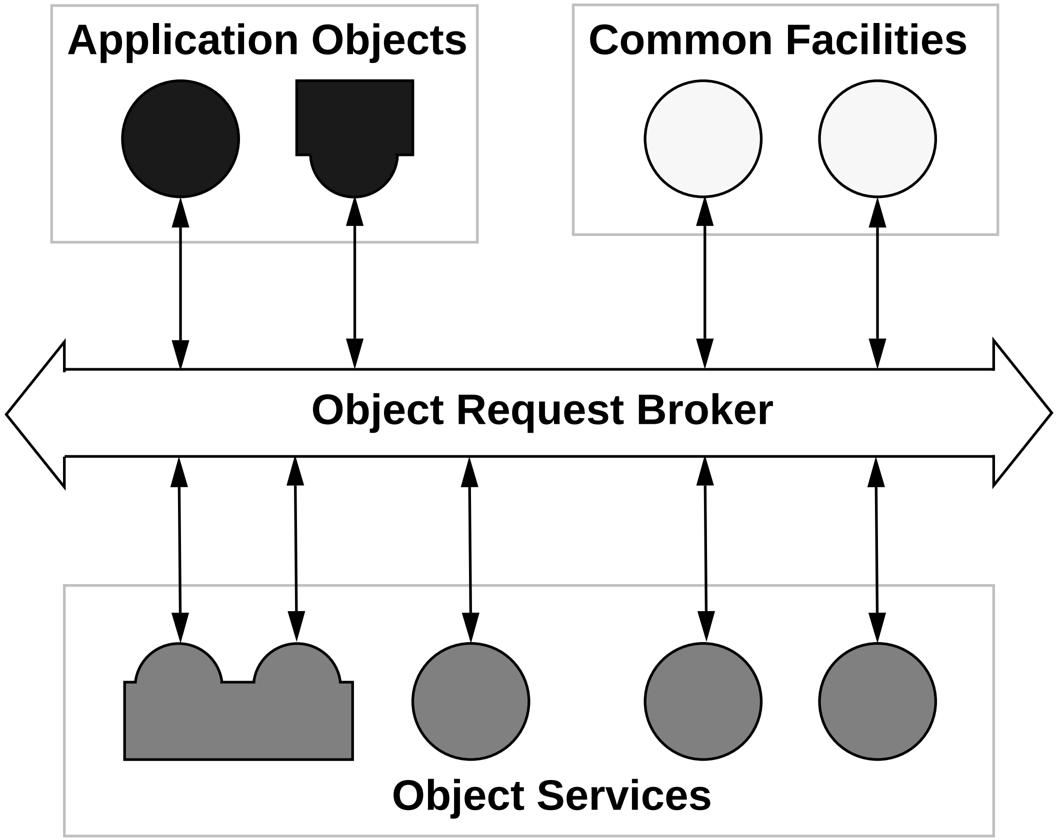
Object Request Broker 2
Andrew Watson (APM)

Object Model Revision
Bill Kent (HP)

Object Services
G Lewis & W Andreas

ORB Revision
Carl Soeder (HP)

Object Management Architecture



Populating the Framework

- **Task Force is formed, issues Request for Information (RFI)**
  - **Everyone invited to respond with whatever material they think relevant**
- **TF studies responses, decides strategy**
  - **Possibly produces Roadmap or Architecture document**
- **TF issues Request for Proposals (RFP)**
  - **Members supply specifications of technology to fill stated requirement**
- **TF recommends a single response to TC, which recommends to board**
- **Task Force dissolved**

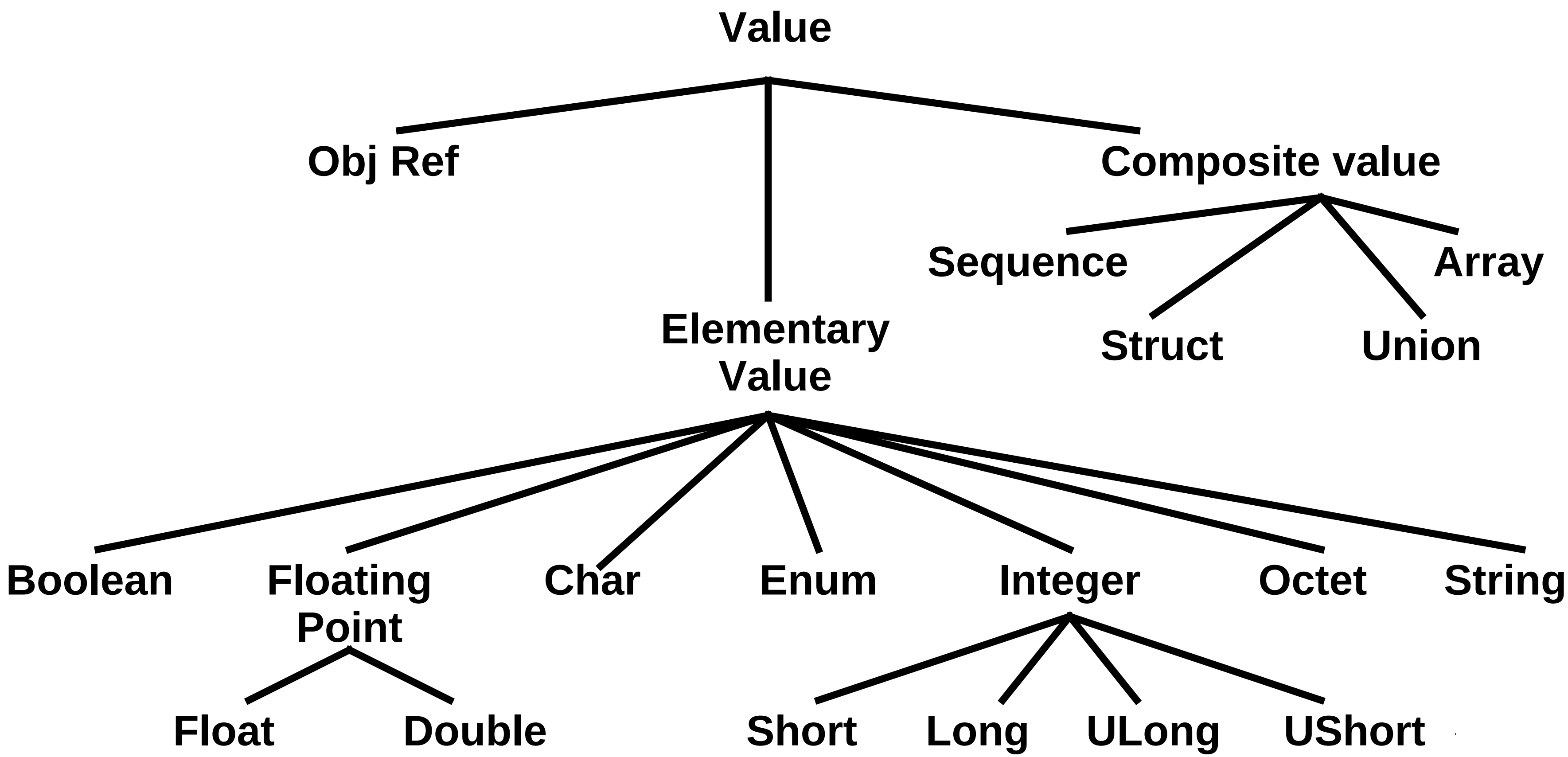
Object Request Broker

- **OMG's first RFP cycle**
  - **RFI closed Aug. 1990 (8 responses), RFP closed Dec. 1990 (10 LOIs)**
- **Seven proposals presented March 1991**
  - **APM, Bull, DEC, DSET, HP/Sun, Hyperdesk, NCR/ODI**
- **Two merged submissions by demonstrations in May 1991**
  - **HP/Sun/NCR/ODI & Hyperdesk/DEC**
- **"90 day" team formed, presented merged proposal (CORBA) in September 1991**
- **Proposal accepted October 1991**

Key CORBA concepts

- **Object**
  - **"Classical" object model: each request directed to a particular object**
- **Object reference**
  - **"Handle" used by client(s) to make invocation on service-provider**
  - **Opaque (i.e. no handle equality test - see Powell's paper)**
  - **May be passed as request parameter**
- **Request**
  - **Operation name + target object ref + zero or more parameters**
  - **Optional "request context" (to "pass additional data about the request")**
  - **Outcome: results or an exception**
  - **Parameters may be IN, OUT or IN/OUT**

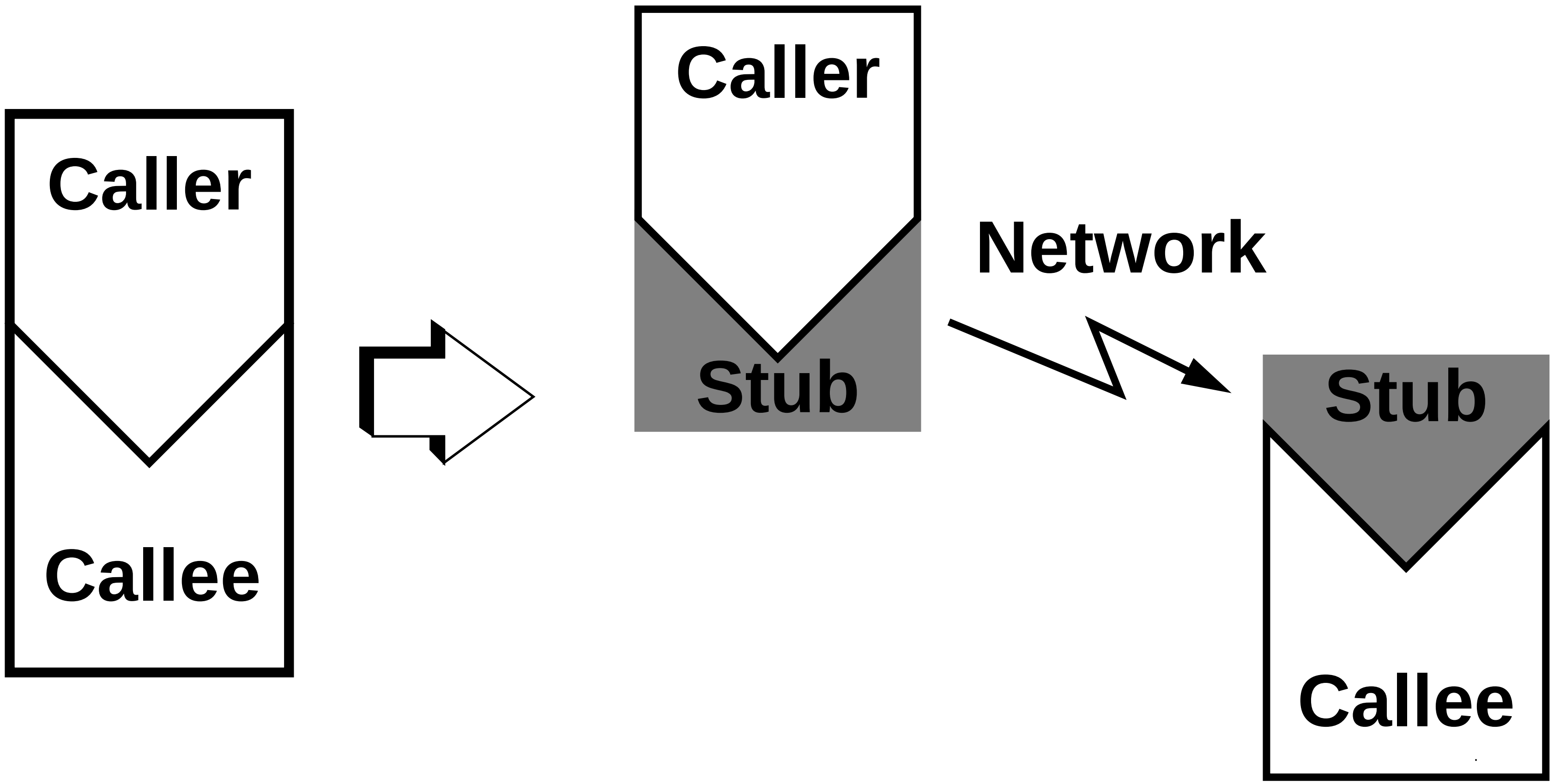
Data Types


Value
Obj Ref
Composite value
Sequence
Array
Struct
Union
Elementary Value
Boolean
Floating Point
Char
Enum
Integer
Octet
String
Float
Double
Short
Long
ULong
UShort

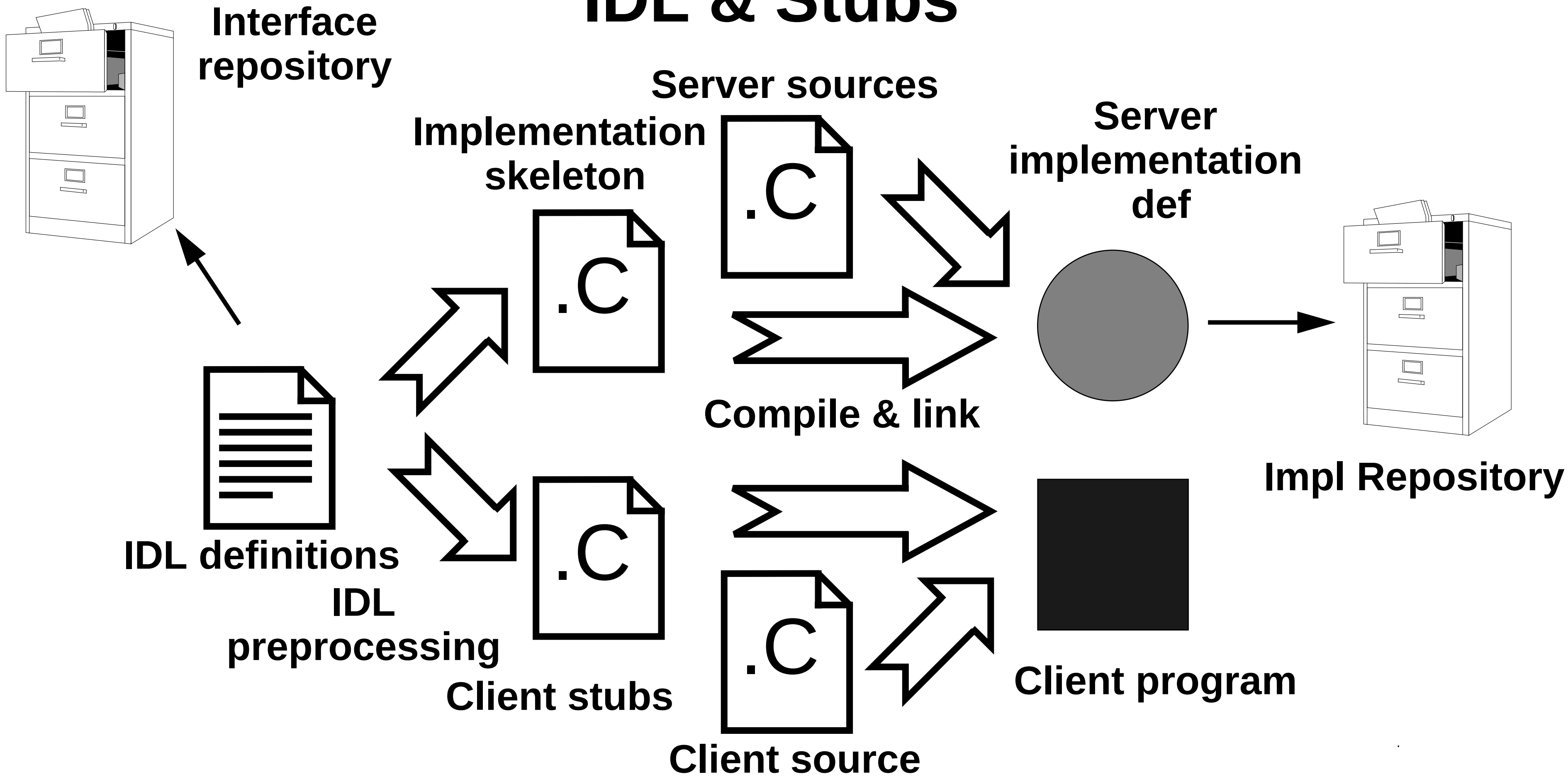
Key concepts (cont.)

- **Interface**
  - Set of operation signatures
  - Identifies requests that can be made on object satisfying that interface
  - Interface = abstract type (abstract class in C++ speak)
- **Operation signature**
  - Operation name + parameter types & directions + exception spec + context spec + semantics (at-most once vs. one-way best-effort)
  - cf. C/C++ function prototype
- **Interface Definition Language (IDL)**
  - Written interface definitions
  - DOESN'T SPECIFY IMPLEMENTATION (despite looking like C++)

Stubs



IDL & Stubs


Interface repository
Server sources
Implementation skeleton
Server implementation def
.C
.C
Compile & link
IDL definitions
IDL preprocessing
.C
.C
Impl Repository
Client stubs
Client program
Client source

Key concepts (cont.)

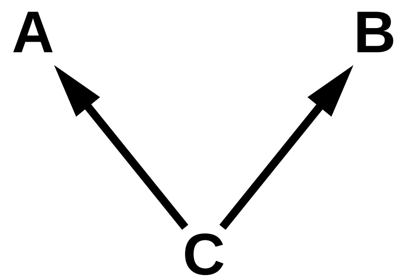
- **Interfaces can be derived from other interfaces by extension**
  - **Creates a subtype (since redefinition of operations not permitted and IDL has no self-reference)**
  - **An interface can be derived from multiple ancestors - but illegal if operation names conflict**
  - **CORBA calls this derivation “inheritance” (sic)**
  - **Merely saves the effort of writing out the new definition in full [I assert]**
  - **Interface B inherits from interface A is a sufficient, but not a necessary, condition for object with interface B to be used with client that expects one with interface A [I assert]**

Interface inheritance & subtyping

```
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}}
```

- **C (either derivation) is a subtype of both A and B**
  - **object with interface C may be substituted where-ever clients expect one with interfaces A or B**

Key concepts (cont.)

- **Object Adaptor**
  - “Glue” that passes incoming invocation into server object
  - Includes implementation skeleton generated from IDL
  - Only Basic Object Adaptor (BOA) specified by CORBA
- **Dynamic Invocation Interface (DII)**
  - Client’s alternative to invoking object’s operations via stubs
  - Req’d only where Lisp programmer would use ‘eval’ (i.e. almost never)
  - Complicated and error-prone: use only if unavoidable
- **Interface Repository**
  - Provides ability to find interface of arbitrary object at run-time (see above)

Why the DII isn't for you

- **For client to make request using stub, target object need only have operation with the right name and signature**
  - No need to know the implementation of the object
  - No need for server's IDL to be identical to (or derived from) the client's
  - No need for server even to exist until client actually makes request
  - Therefore, usually no need for DII: stub-based client can do the job
- **DII forces programmer to build parameter lists etc "by hand"**
  - No check that he got it right until run-time
  - Large API, lots of code
  - Only necessary if writing language interpreter, object browser etc
- **"If you can write it in C++, you can use a stub"**

Invocation semantics

- **CORBA invocations are request/response ("synchronous")**
  - Therefore your CORBA implementation must have threads for clients
- **"One way" invocations also available**
  - Unreliable
  - Correct implementation of CORBA could throw away every 10th one-way invocation ... or every second one ... or all of them
  - ... and before you say it, yes this isn't much use to you!
  - One-way provided for access to the comms, to build blast protocols etc
  - Queued message delivery positioned as object service
- **Deferred synchronous also available via DII**

Availability

- One or two companies have ORBs available today (9/93)
- Several are in beta test
- Many companies (100?) are working on ORBs and related products
- Compliance issue

Future developments

- **CORBA = ORB 1.1**
- **ORB 1.2 Revision Task Force working on clarifying some obscurities in 1.1**
- **ORB 2.0 Task Force about to issue RFPs**
  - **Interoperability & Initialisation - initial responses due March 94**
  - **Interface repository - initial responses due May 1994**

Equality

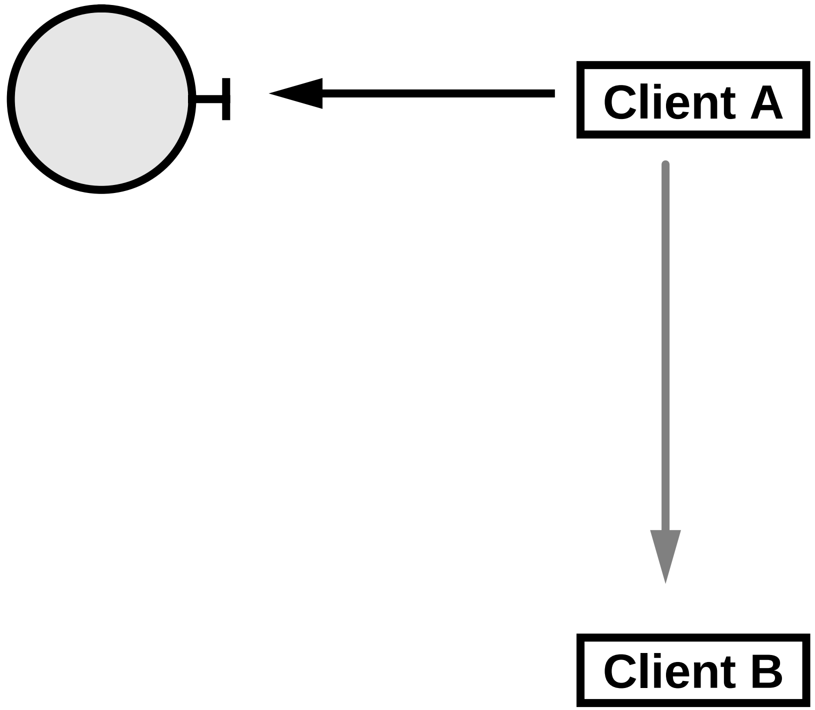
- **Must distinguish (at least) two kinds of equality (sameness):**
  - **Same contents (equality of information an object represents)**
  - **Same container (often detected via equality of object references)**
  - **“Same container” implies, but is not implied by, “same contents”**
  - **“Same pointer” implies, but is not implied by, “same container”**
- **Application programmers care about information, not representation**
  - **Example: CLtL explains built-in data types in terms of abstract data**
  - **Lisp `equal` can be explained in these terms, eq cannot; `equal` is about equality of abstractions, eq about “same pointer” (CLtL2, p103-104)**
  - **Numbers are defined to be `equal` to themselves, but fixnums “may or may not be” eq to themselves**

Equality (cont.)

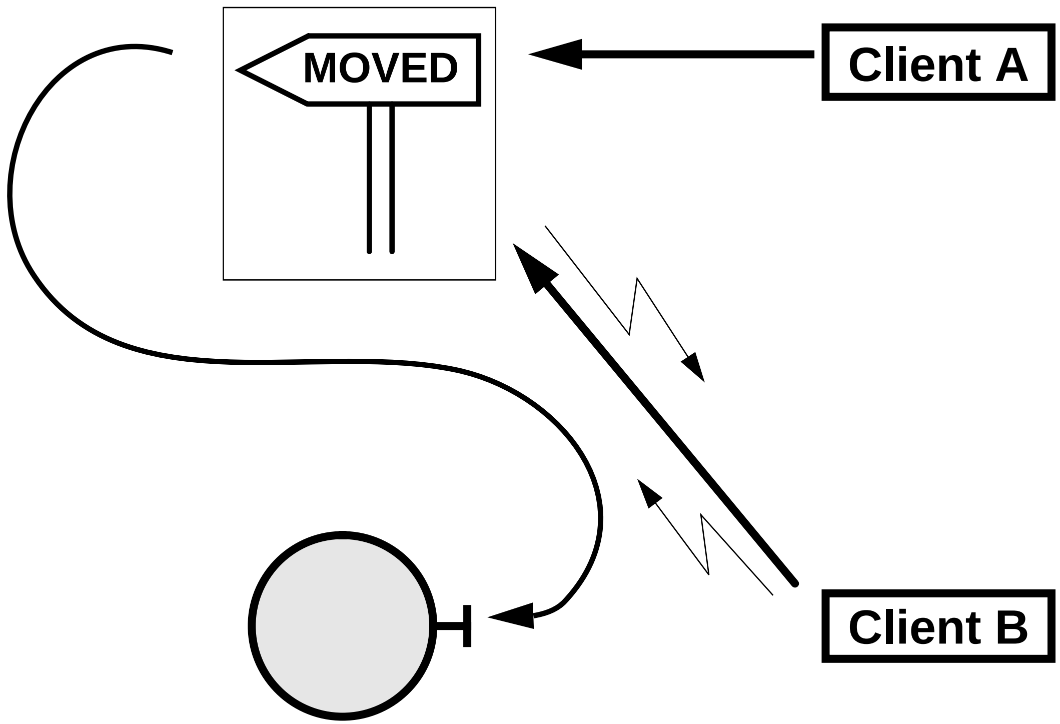
- **If "same pointer" test fast and easy, it can be used to short-circuit "same contents" test**
  - **`eq` is one or two instructions in a good CL implementation**
  - **Experienced programmers in Lisp, ST-80 design their data types so that "same contents" (`equal`) *does* imply "same pointer" (`eq`)**
  - **Makes application equality tests efficient, at some expense when setting up data representation (e.g. interning symbols)**

- **"Same pointer" test (`eq`) is the "same container" test only if pointer(x) = copy(pointer(x)) always**
  - **Easy & natural in non-distributed infrastructure**
  - **Useful distributed infrastructure designs may not maintain this invariant**

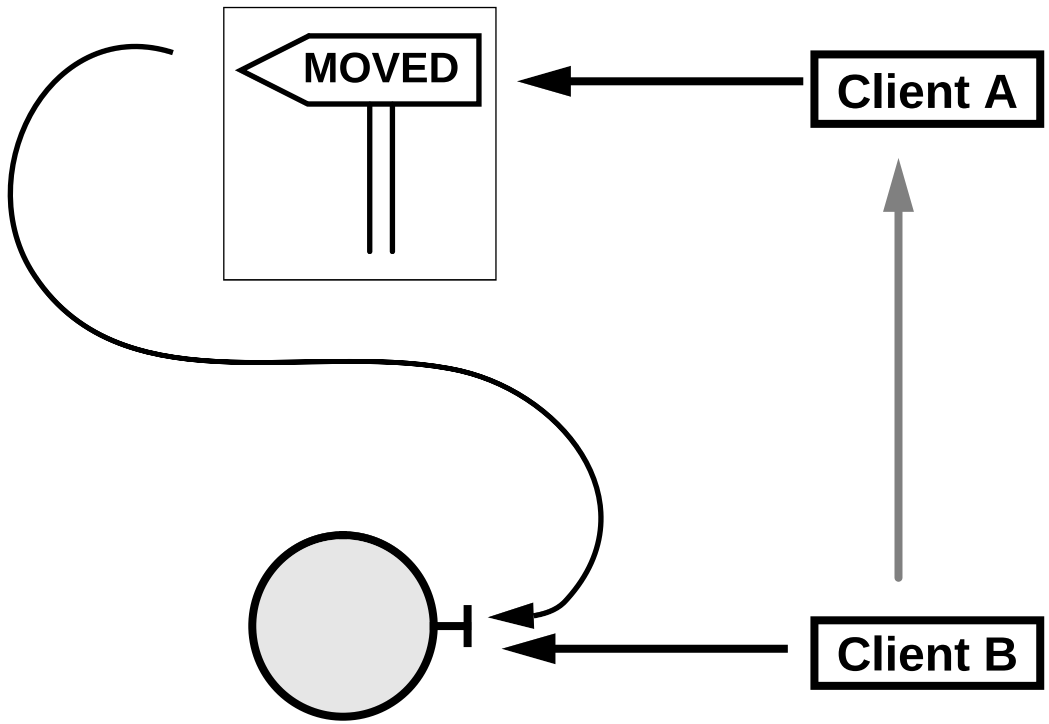
Same container vs. same pointer



Same container vs. same pointer (cont.)



Same container vs. same pointer (cont.)



Equality - conclusions

- **"Same container" test in a distributed environment may be as expensive as calling application-defined "equal" method**
- **In any case, placing "same container" test in the application programmer's model is a (weak) violation of encapsulation**
  - **Clients' correct operation could depend on eq-ness of operation results**
  - **Apparently-innocuous changes to object implementation would cause clients to behave differently**
- **"Same pointer" and "same container" tests should be part of the implementor's (engineering) view of an ORB, but absent from the application programmer's (computational) view**

Type issues

- **Anyone want to discuss F-bounded quantification?**