CSCE 455/855
Distributed Operating Systems

CORBA

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CORBA

- Common Object Request Broker Architecture
  - » specification for object-request architectures
    - ❖ i.e. match object requests with implementations
    - ❖ distributed object platform/framework
  - » CORBA is not a working product
    - ❖ it is a specification

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CORBA

- Object Management Group
  - » consortium that created CORBA and related technologies
    - Sun, HP, Oracle etc. (700+ members)
    - Microsoft is not a member of the consortium
      - why?
  - » OMG creates the specs…
    - that can then be turned into products by various vendors
    - if vendors stick to specs,
    - should be able to run with any CORBA implementation

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The CORBA Vision

- Define a way to divide application logic among objects distributed over a network
  - » using standards
    - allow any operating system, machine, language
    - ...to be involved on creating a component
  - » as long as the standard is complied with
    - objects should be able to work together
  - » the death of language religious wars!!
- Achieved through a distributed object architecture
  - » I.e. object-oriented + distributed heterogeneous objects

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The CORBA Vision (cont.)

- Separation of interface and implementation
  - » create a well-defined interface to an object
    - ❖ parameters passed to the object
    - ❖ data returned
    - ❖ define the form (type, structure) of parameters and return values
  - » given a well-defined interface, implementation doesn't matter
    - ❖ can change the implementation without impacting rest of the application (o-o concept)
    - ❖ doesn't have to be programmed in the same language
    - ❖ …or reside on the same machine

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Object Management Architecture (OMA)

- OMA Components
  - » CORBA
    - ❖ connects objects, not applications
  - » CORBA*services*
    - ❖ low-level functionality needed by objects, such as security, time, persistence, transaction, and naming services.
  - » CORBA*facilities*
    - ❖ user-level facilities, such as document management, help facilities, and system administration, provided to applications .

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CORBA Components

- Object Request Broker (ORB)
- OMG Interface Definition Language (IDL)
- Language Mappings
- Interface Repository (IR)
- Dynamic Invocation Interface (DII)
- Object Adapters (OA)
- Inter-ORB Protocols (e.g. IIOP)

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Object Request Broker

- Object Request Broker (ORB)
  - » middleware that establishes client-server relationship between objects
  - » links object requests to implementations
- Using an ORB
  - » client requests a service
  - » ORB intercepts the call and finds an object that can implement the request
    - ❖ do necessary translation in passing parameters, getting results
  - » client acts as though its calling a method in the system
    - ❖ client doesn't have to know details

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ORB (cont.)

- ORB location services
  - » ORB is free to choose an implementation
  - » if a host is down, choose another object
    - ❖ …that satisfies the request
- Requires that objects are written with certain requirements
  - » global naming scheme (object reference)
  - » registration of services
    - ❖ each object tells what services it provides

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Interface Definition Language (IDL)

- IDL is a language used to define interfaces
  - » objects must then implement the interface faithfully
  - » clients only see the IDL interface definition
- IDL is a declarative language
  - » meaning it only allows declarative statements
  - » no conditionals, loops, etc.
  - » supports most basic types (short, long, float, etc)
    - ❖ also some derived types (string, structures, arrays, etc.)

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IDL (cont.)

- Most important - creates an interface
  - » interface defined as a collection of specifications that define an API set
  - » interfaces contained in a module
    - modules define a local name space
    - therefore global name space is only concerned with module names
    - somewhat like packages in Java
  - » operation is the specification of a method call
    - signature (operation name, return type, parameter list)
  - » exceptions can be raised (raises)
    - handled by client code
  - » can also declare a context for an operation
    - name-value pairs similar to UNIX or DOS environment variables

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IDL Example

```
module <module name> {
   <user-defined type declarations>;
   <constant declarations>;
   <exception declarations>;

   interface <interface-name> [:parent-interface-name] {
      <user-defined type declarations>;
      <constant declarations>;
      <exception declarations>;
      <attribute declarations>;

      [operation-type] <operation-name> (<parameter list>)
         [raises exception_name, …] [context (context1, …)];

      [operation-type] <operation-name> (<parameter list>)
         [raises exception_name, …] [context (context1, …)];
   }

   interface  <interface-name> [:parent-interface-name]
   …
}
```

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Language Mappings

- Map IDL to language features
  - » for example in C++
    - ❖ IDL Module → C++ namespaces
    - ❖ IDL interface → C++ class
    - ❖ IDL char → C++ char
    - ❖ IDL octet → C++ unsigned char
- OMG defines standard language mappings
  - » C, C++, Smalltalk, Ada, COBOL, Java
  - » other independent mappings (e.g. Perl, Eiffel, Modula-3)
- Mappings are embedded in IDL compilers
  - » each language has a specific IDL compiler

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IDL Compilers

- IDL compilers create stubs
  - » referred to as stubs on the client side
  - » skeletons on the server side
  - » clients interface with stubs
    - ❖ to communicate with ORB
  - » orbs interface with skeleton
    - ❖ to communicate with server
- Known as “static Method Invocation”
  - » stubs and skeletons directly linked into code

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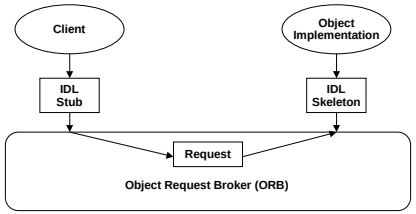
IDL Interface to ORBs

- IDLs define stubs similar to RMI/RPC
  - » stubs marshal parameters to/from the ORB



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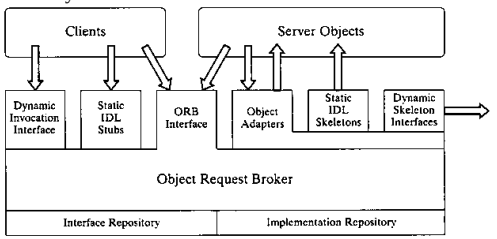
Interfacing to an ORB

- Multiple ways to interface with ORBS
  - » static IDL stubs
    - ❖ as in previous slides
  - » dynamic invocation



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Interfacing to an ORB

- Dynamic invocation
  - » Dynamic Invocation Interface (DII)
  - » Interface Repository (IR) stores
    - ❖ interfaces
    - ❖ references
    - ❖ objects' inheritance hierarchy and all operations it supports
  - » ORB matches dynamic request to a DSI
    - ❖ protocol for client to get object reference, interface
- Dynamic Skeleton Interface (DSI)
  - » equivalent of DII for server-side
  - » ORB access servers without static skeletons

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Interface Repository (IR)

- Allows clients to programmatically discover type information at run-time
  - » primary utility is supporting dynamic method invocations
- IR stores object
  - » interface definitions
  - » inheritance hierarchy (graph)
  - » all operations supported
- Services of IR can be accessed through
  - » Standard IR IDL interface
  - » Custom libraries provided by ORB vendor

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Object Adapters (OA)

- Responsible for object activation transparency
  - » intermediate layer that connects the ORB and the object implementation
  - » different OA for each supported programming language
- Main duties
  - » object registration
  - » generation of object references
  - » object activation
  - » activation of server process
  - » request handling

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ORB-to-ORB Communication
Inter-ORB Protocols

- Direct ORB-to-ORB communication
  - » ORBs are in same domain (common IDL type systems)
  - » General Inter-ORB Protocol (GIOP)
    - ❖ Internet Inter-ORB Protocol (IIOP)
- Bridge-based communication
  - » ORBs from different domains
  - » Environment-Specific Inter-ORB Protocols (ESIOPs)
    - ❖ Distributed Computing Environment Common Inter-ORB Protocol (DCE CIOP)
      - ◆ allows for easy integration of CORBA and DCE applications

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Java vs. CORBA

- Both have similar goals
  - » creating software objects that can run “anywhere”
  - » CORBA also adds a strong distributed theme
- Achieved in different ways
  - » Java: architecture neutrality
    - ❖ JRE allows code to run on any system (with a JRE)
    - ❖ model is a single monolithic application
  - » CORBA: transparent communication
    - ❖ invocation of objects is transparent
    - ❖ model is a set of (potentially distributed) objects working together to create an object
    - ❖ platform dependency is allowed, but communication transparency hides dependencies

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Java vs. CORBA (cont.)

- Language Dependencies
  - » Java: one language
  - » CORBA: bridge differences in languages
    - ❖ can run into ORB dependence (commercial ORBs have differences)
- Distributed Services
  - » Java: no explicit support for distributed objects
    - ❖ although RMI is a start
  - » CORBA: model is based on distributed objects
- Scale of systems
  - » Java: works for large or small apps
  - » CORBA: too much infrastructure for small apps

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