Java RMI

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Java RMI

- Java language had no mechanism for invoking remote methods
- 1995: Sun added extension
  - **Remote Method Invocation** (**RMI**)
  - Allow programmer to create distributed applications where methods of remote objects can be invoked from other JVMs

RMI components

Client
- Invokes method on remote object

Server
- Process that owns the remote object

Object registry
- Name server that relates objects with names

Interoperability

RMI is built for Java only!
- No goal of OS interoperability (as CORBA)
- No language interoperability
  (goals of SUN, DCE, and CORBA)
- No architecture interoperability

No need for external data representation
- All sides run a JVM

Benefit: simple and clean design

RMI similarities

Similar to local objects

- References to remote objects can be passed as parameters (not really)
- Objects can be passed as parameters to remote methods (but not as a reference)
- Object can be cast to any of the set of interfaces supported by the implementation
  - Operations can be invoked on these objects

RMI differences

- Non-remote arguments/results passed to/from a remote method by copy
- Remote object passed by reference, not by copying remote implementation
- Extra exceptions

New classes

- **remote class**:
  - One whose instances can be used remotely
  - Within its address space: regular object
  - Other address spaces: can be referenced with an **object handle**
- **serializable class**:
  - Object that can be marshaled
  - If object is passed as parameter or return value of a remote method invocation, the value will be copied from one address space to another
    - If remote object is passed, only the object handle is copied between address spaces

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needed for parameters

Stubs

Generated by separate compiler

rmic

- Produces Stubs and skeletons for the remote interfaces are generated (class files)

Naming service

Need a remote object reference to perform remote object invocations

Object registry does this: **rmiregistry**

Server

Register object(s) with Object Registry

```
Stuff obj = new Stuff();
Naming.bind("MyStuff", obj);
```

Client

Contact *rmiregistry* to lookup name

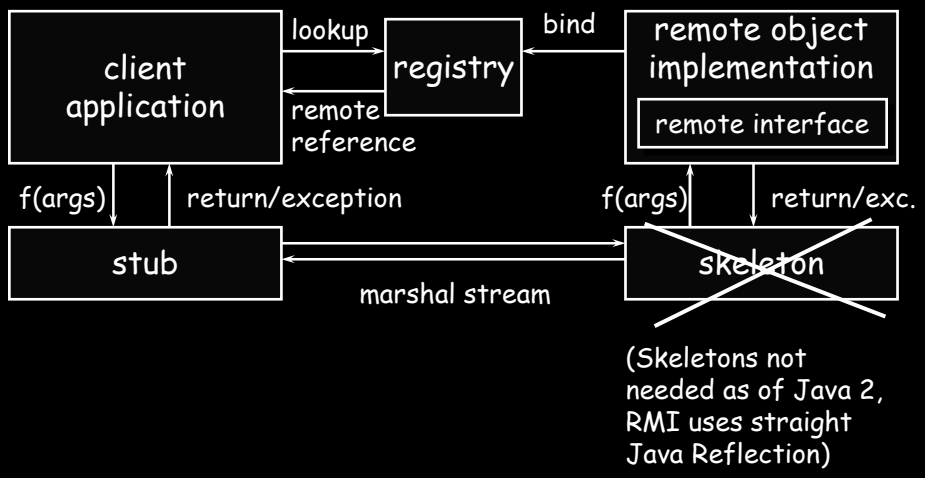
```
MyInterface test = (MyInterface)
    Naming.lookup("rmi://www.pk.org/MyStuff");
```

rmiregistry returns a remote object reference.
lookup gives reference to local stub.

Invoke remote method(s):

```
test.func(1, 2, "hi");
```

Java RMI infrastructure



RMI Distributed Garbage Collection

- Two operations: *dirty* and *free*

- Local JVM sends a *dirty* call to the server JVM when the object is in use
  - The *dirty* call is refreshed based on the lease time given by the server
- Local JVM sends a *clean* call when there are no more local references to the object