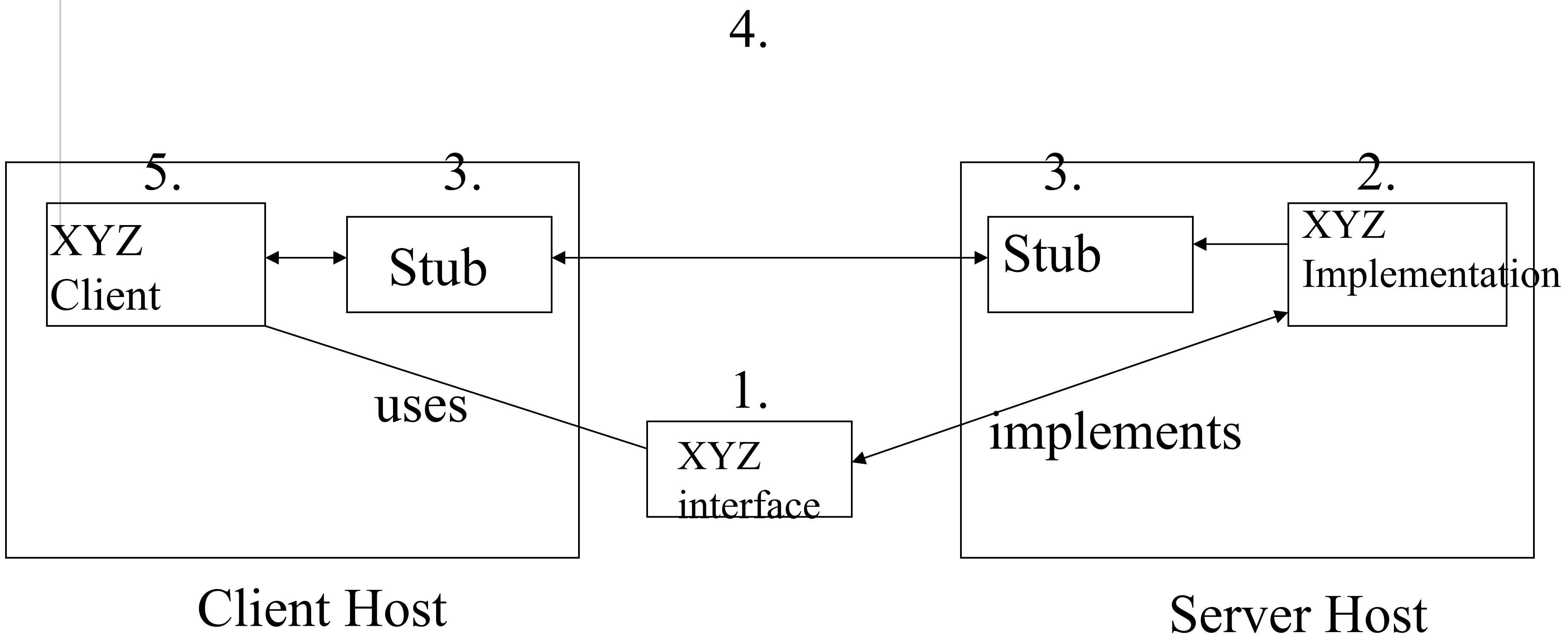
Creating a Distributed System with RMI

B.Ramamurthy

Remote Method Invocation

- Remote Method Invocation (RMI) is Java’s implementation of object-to-object communication among Java objects to realize a distributed computing model.
- RMI allows us to distribute our objects on various machines, and invoke methods on the objects located on remote sites.
- Source code for the demo is a modified version of code in Chapter 20 of Deitel & Deitel’s text Java : How to Program.

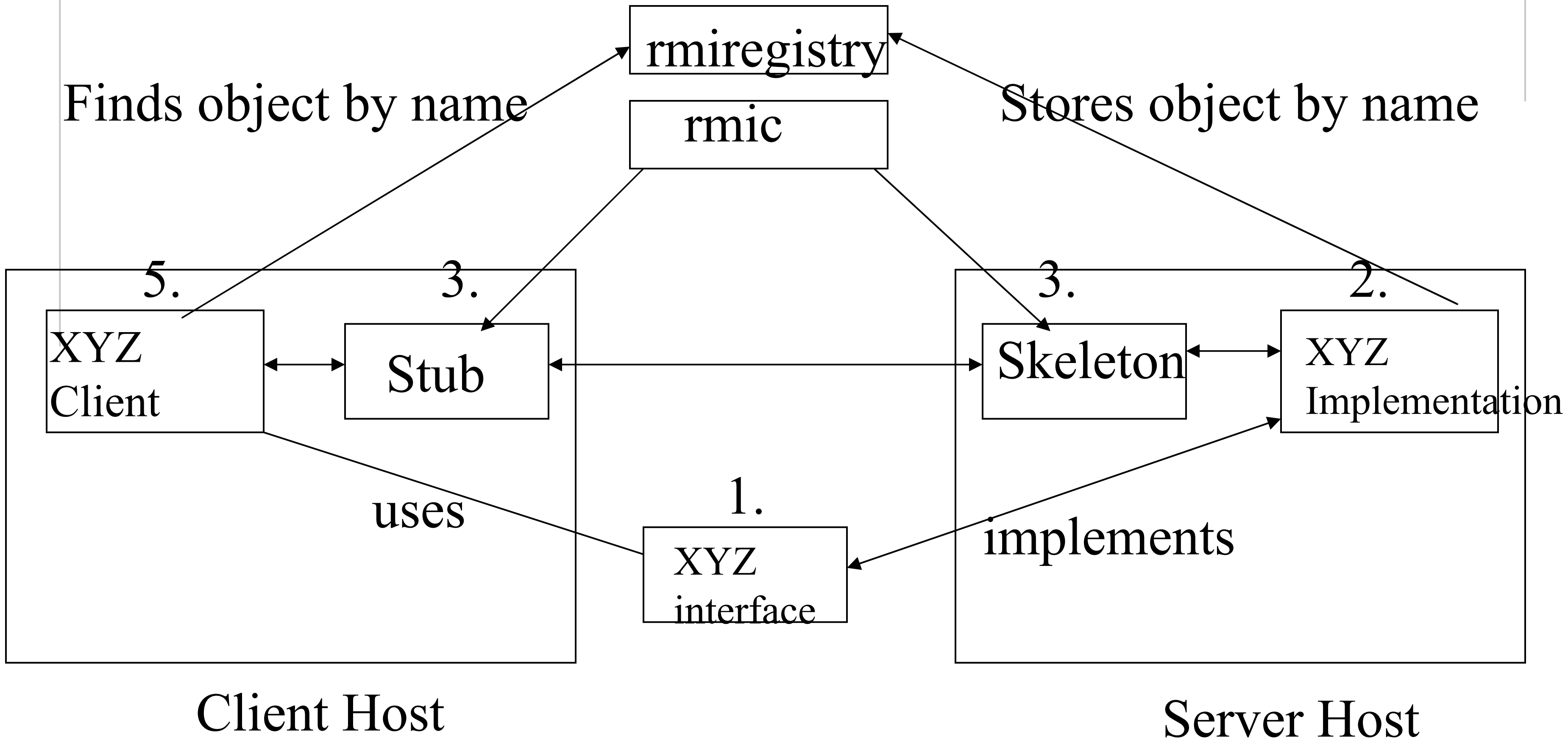
RMI-based Distributed System



Steps in RMI-based Application

1. Design the interface for the service.
2. Implement the methods specified in the interface.
3. Generate the stub and the skeleton.
4. Register the service by name and location.
5. Use the service in an application.

Compile and Register Commands



More Details

- Once the object (or service) is registered, a client can look up that service.
- A client (application) receives a reference that allows the client to use the service (call the method).
- Syntax of calling is identical to a call to a method of another object in the same program.

Parameter Marshalling

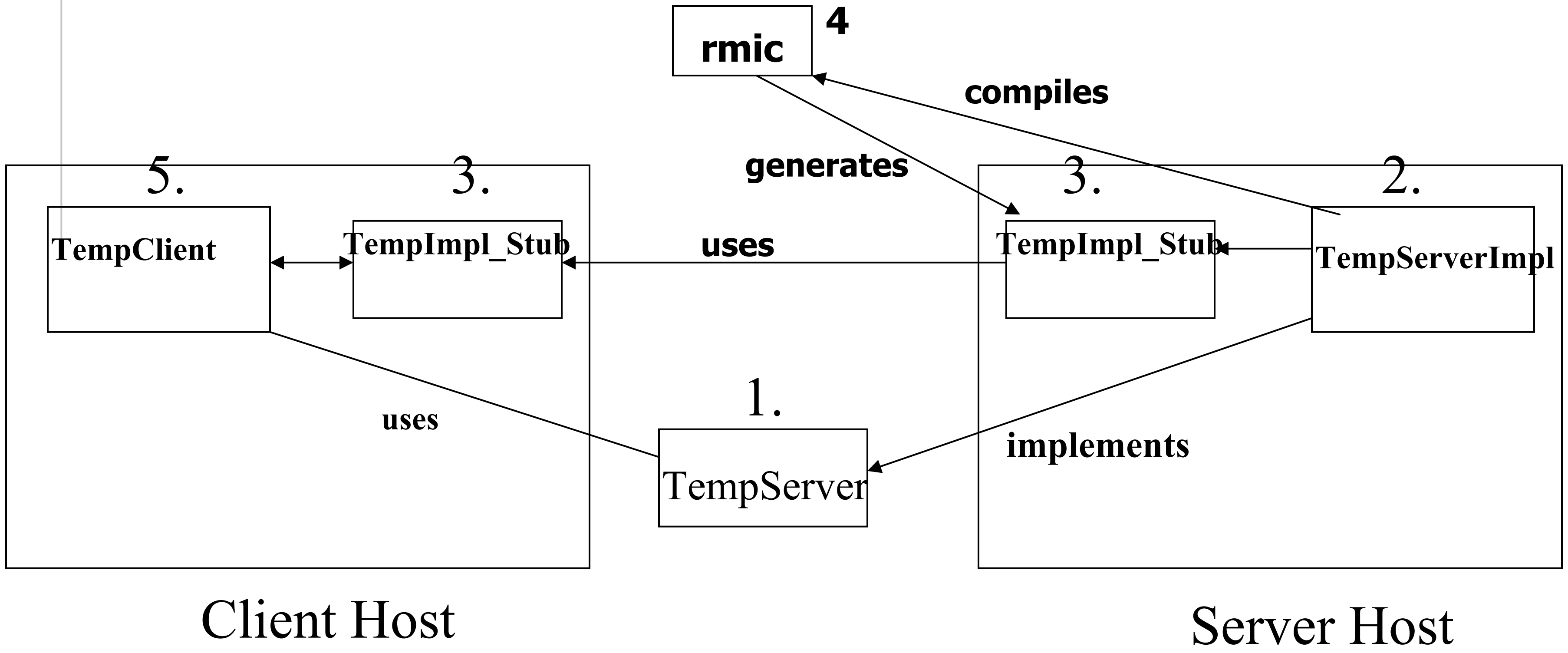
- Transfer of parameters (or marshalling) is done by the RMI.
- Complex objects are streamed using Serialization.
- RMI model of networking for distributed system involves only Java.
- No need to learn IDL or any other language.

Case Study : Temperature Service

- Lets create a distributed system using RMI model for networking (remote access).
- Basically this program will download the weather (temperature) information from the site:

http://iwin.nws.noaa.gov/iwin/us/traveler.html

Temperature Client/Server Distributed Application



Defining Remote Interface

```
import java.rmi.*;
// the interface extends Remote interface
// any class implementing Remote can be
   accessed remotely security permitting
public interface TemperatureServer extends
   Remote
{  // specify methods that can be called
   remotely
   // each method “throws RemoteException”
}
```

RemoteException

- Any time you depend on outside entities there is a potential for problems in communication, networking, server crash etc.
- Any exception due to these should be handled by the services.
- This feature imparts robustness to the application.
- Java mandates this feature for any RMI service.

Implementing the Remote Interface

```
import java.rmi.*;
import java.rmi.server.*;
import java.net.*;
// others as needed
TemperatureServerImpl
      extends UnicastRemoteObject
   implements TemperatureServer {
```

TemperatureServerImpl

- This class's constructor calls a private method which in turn:

1. Connects to the url specified
2. Streams into a buffer the page referenced.
3. Parses the buffer to get the required data.
4. Creates an array of weather information.

TemperatureServerImpl (contd.)

- It implements the service method getWeatherInfo which simply returns the weather data gathered.
- The main method instantiates an object for the service, and registers it with rmiregistry.

Streaming URLs

- Using the openStream of java.net.URL class you can stream in the file spefied by an universal resource locator(url).
- It can be streamed into a buffer where it can be analyzed for information.
- Any number of urls can be streamed in.
- Unicast Communication : When you are interested in a particular remote site you will direct your net connection to that particular site using unicast.

Server Object Name

- Syntax for the server object name is:

//host:port/remoteObjectName

- Default port number for rmiregistry is 1099
- For local host the object name:

//localhost/TempServer

For a remote host

//127.0.0.1/TempServer

Name Binding

- rebind method binds a server’s object name to the object’s name as it is in the registry.
- Clients use the name in the registry.
- There is also a bind() method.
- But rebind is better since it binds the most recently registered object.

WeatherInfo class

- It is very traditional class for keeping the information about the temperature at a single location.
- It has data fields : cityName, temperature, and description and get methods for these.
- An array of objects of this class is used in the server implementation.

Temperature Client

```
import java.rmi.*;
 // import other packages
```

- constructor calls a private method getRemoteTemp which takes care of lookup of remote object and access.
- In this application it also displays the information.

Temperature Client (contd.)

- The main method in this client can get the IP address of the remote host as a command line argument.
- Command line argument is an array of String of items in the command line after the name of the application.

Client Details

- The name of the server object along with the IP of the remote location is used in Naming class's lookup method to get an object reference.
- This object reference is then used for remote method calls.
- Observe that there is no difference between the local and remote call.
- WeatherItem class used in the Graphical display of the weather information.

Preparing the Application

1. Compile all the class using **javac**.
2. Generate the stub and the skeleton:

rmic -v1.2 TemperatureServerImpl

3. Then start the registry (this will be running as a daemon)

rmiregistry &

Preparing the Application

4. Run the server which will register with the RMI registry.

```
Java TemperatureServerImpl &
```

5. Run the client.

```
Java TemperatureClient &
```

or

```
java TemperatureClient {IPAddress}
java TemperatureClient 192.168.0.150
```

Summary

- We discussed the various models of distributes systems.
- Java RMI was used to illustrate the distributed system concepts.
- Temperature examples shown illustrates some of the distributed system model discussed and all the important RMI features.