

Distributed Systems Overview

In this course we shall be covering the following topics:

1. Socket programming
2. Multicast
3. NTP
4. RPC
5. Java RMI
6. CORBA (Java IDL)
7. JINI
8. UPnP
9. OpenSSL

Although the assignment will not cover all of these topics remember that the exam will.

You should aim to demonstrate working code to your lab tutor of each topic. You should discuss amongst your peers the benefits and short-comings of each of these technologies.

Worksheets and supporting material will be made available on the module homepage. However it is expected that you will find additional resources to answer the review questions.

1) Socket programming

Concept in one line: Sockets are the core of distributed programming. ...

Tasks: You should develop a simple client server application. The client should post messages to the server; the server will simply print these out to the screen. Once you have this working why not test it with a neighbour.

Review Questions/Tasks:

- If you have time you might like to compare the C and Java (or C#) equivalent code implementations.
- What are the advantages and weaknesses of each approach?
- You should review the core lifecycle methods: accept(), bind(), listen() etc
- What are well known port numbers? What is the range?

2) Multicast

Concept in one line: IP multicast is a protocol used for sending messages from one party to multiple receivers.

Tasks: Building on the previous weeks work, modify the client server application to create a simple chat application that enables n clients to exchange messages with each other. The aim of the application is that clients

register a nickname with the server and then post messages that are distributed to all registered clients. The client should send one message that is relayed to all over clients. Do not over complicate the program, for example, registration should be simple, i.e. just submit a user name.

Work in groups consisting of two pairs. One pair should implement the solution in C whilst the other should use a higher level language such as C# or Java. Once each pair has completed their implementation present the solution to the other pair, explaining exactly how the code works. Then try and get this working with other groups.

Review Questions/Tasks:

- What is a multicast IP address?
- What is it useful for? - Service discovery.
- Is reliable multicast possible?

3) NTP

Concept in one line: The Network Time Protocol is used to synchronise distributed computer clocks.

Tasks: Have a quick scan through the following RFCs': 1305 and 2030. Write a simple NTP client to determine the time. Extend this to discover an NTP server in the lab (multicast) and use this server to discover the current time.

Review Questions/Tasks:

- In small groups, discuss how NTP works.
- Why do we need to synchronise time?
- Are there any other time synchronisation protocols?
- What transport protocol does NTP use, TCP or UDP? Why?
- What port number does NTP use?

4) RPC

Concept in one line: RPC enables a remote host to execute code on another machine. (Remote Procedure Cell)

Tasks: Write a program to obtain the time of a remote machine.

Review Questions/Tasks:

- Has RPC ever been in the news for anything unwanted?
- What are the advantages of an RPC approach over a socket approach?

5) Java RMI

Concept in one line: Java RMI is an API for managing remote method invocations.

Tasks: Develop a simple client server application to retrieve the server time. Create a chat application with similar functionality to that of the multicast exercise. Synchronise your server using the NTP code from week 3 and timestamp messages.

Review Questions/Tasks:

- What is JRMP?
- What is the advantage of this approach over RPC and sockets?
- Are there any limitations or drawbacks to this approach?

6) CORBA (Java IDL)

Concept in one line: CORBA, like RMI is a middleware, hence it provides various API's for developing distributed applications.

Tasks: Develop a simple client server application to retrieve the server time. Create a chat application with similar functionality to that of the multicast exercise. Synchronise your server using the NTP code from week 3 and timestamp messages.

Review Questions/Tasks:

- Compare the approaches of Java RMI, .NET Remoting and CORBA.
- What is an ORB?
- What does IDL stand for?
- What are the advantages of the interface and implementation approach?

7) JINI

Concept in one line: JINI enables clients and services to locate each other in order to work together to complete a task.

Tasks: Create a simple JINI service to display images located on a remote machine on a client machine. You will find some sample image and Java GUI code on the module homepage. You will also find the shell for a JINI service, you will need to merge the two to create the picture service.

Review Questions/Tasks:

- Why do we need services like JINI?
- Are there any other equivalent services?
- How are services advertised in JINI?

- How are they discovered?

8) UPnP

Concept in one line: UPnP enables devices to connect seamlessly without the use of device drivers.

Tasks: Create a UPnP enabled file browser. You will need to develop a component to list all of the files in a given directory. The second component will use display this list of files via UPNP. You should base this on either the Cyberlink stack or the Intel stack that is available in the labs.

Review Questions/Tasks:

- Why do we need UPNP?
- What is the purpose of control point?
- What are the current problems with UPNP? Vendor specific?

9) OpenSSL

Concept in one line: OpenSSL provides an open implementation of the SSL protocol.

Tasks: Modify the html-ls-server C code provided on the module website to use SSL to provide a secure connection. Implement both server and client authentication. (Two certificates, one for the server and one for the client.) Create you own certificate authority and sign your generated certificates. Do not the sample certificates provided with the source. For full details of this task please see your assignment.

ASSESSED: You will need to submit the source code as part of your assignment.

Review Questions/Tasks:

- Why do we need SSL?
- What is a certificate? Is it a key?
- What is public-private key encryption?
- Can it be broken via brute force?

Sign Off Sheet

Please submit this signoff sheet with your assignment.

Task No.	Task Topic	Signed	Date
1	Socket programming		
2	Multicast		
3	NTP		
4	RPC		
5	Java RMI		
6	CORBA (Java IDL)		
7	JINI		
8	UPnP		
9	OpenSSL		