Exam in Distributed Information Systems

Date 2007-03-14
Course code 1TS160
Exam time 90 + 90 + 120 minutes
Problems 6, Total 30 points
Teacher Lars-Åke Larzon
Phone 070-5228109
Aid Course book and material available on the course homepage

Name: _____________________________________________
Personnr: _________________________________________

Indicate what problems you have handed in solutions to with an 'X' in the 'hand-in' column

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TOTAL
Grade

Include this page with your answers

Before handing in your answers, ensure that:

• You have the answer to at most one problem at each answer sheet.
• The problem number, your name and personnr is clearly stated at each answer sheet.
• The sheets are sorted.
1 A real-time application

Your partner has decided to spend a year as a student in southern France, while you have to stay in Uppsala. Luckily, you can communicate cheaply using Internet telephony.

Your Internet connection has a bitrate of 128 kbit/s in each direction for incoming and outgoing traffic respectively. The telephone software you use encode audio at 112 kbit/s. What is the minimum perceived latency that can be experienced between you and your partner? 1 kbit equal 1000 bits.

The bottleneck link when you communicate is your own Internet connection, which means you do not want to exceed 128 kbit/s at any time to avoid packet loss. The time from when a frame is enqueued for delivery at your computer until the enclosed audio clip is delivered to the application at the other end is 80 ms ± 20 ms.

2 RPC and RMI

You have designed a distributed system that uses RPC or RMI for the client/server communication. Now, you want to enhance the communication part of the system to get better overall performance. Suggest two enhancements for this, i.e., two enhancements that improve the communication part in a RPC/RMI-based system.

3 Agreement and Coordination

Show by way of example that the usage of a ring-based algorithm for mutual exclusion not necessarily guarantees access to a critical section in happened-before order.

4 Security

Compare filter-based firewalls to proxy-based (a.k.a. application gateways) with respect to differences in operation, limitations and impact from IPsec and SSL.

5 Transactions

a) Consider two transactions \( T \) and \( U \) defined as follows:

\[
\begin{array}{c|c}
T & U \\
\hline
x = \text{read}(i); & \text{write}(i, 55); \\
\text{write}(j, 44); & \text{write}(j, 66);
\end{array}
\]

Describe an interleaving of \( T \) and \( U \) that is not serially equivalent if locks are released early.

b) We have repeatedly said that when a transaction is aborted, everything is restored to its previous state, as though the transaction had never happened. We lied. Give an example where it is impossible to reset everything.
6 Selected items

The TCP/IP protocol stack consists of 5 layers: application, transport, network, link and the physical layer. Pick 3 examples of protocols or mechanisms from the middle three layers (one from each). For each example of protocol or mechanism, you must:

- Present its name or acronym
- Present its purpose
- Outline its functionality, i.e., how it works
- Describe why it is a well chosen example according to the criteria below

Your examples should be chosen so that:

- One is related to synchronization
- One is related to coordination
- One is related to replication

(6p)