UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION, APRIL 2001

MIE452H1S - DISTRIBUTED INFORMATION SYSTEMS

Exam Type: B

Examiner: D.M. Frances

Please answer 7 out of the following 10 questions – all questions are worth 15 marks:

1. Describe how your e-mail client application, and the e-mail client of your recipient, might use private keys, public keys, digital certificates, RSA and MD5, to reassure the recipient that the message was signed by you.

2. Describe and illustrate how the RSA algorithm calculates complementary numbers, and explain the use of these numbers for asymmetric encryption with private and public keys. Note: Use P=3, Q=17 to illustrate how to encode and decode the number 5.

3. Describe and illustrate how the Network Time Protocol (NTP), including the UTC source, the network of time servers, the stratum organization, the synchronization dispersion– the estimated offset and delay - at each server, is used to minimize the discrepancies between the physical clocks in a distributed system.

4. Why is NTP insufficient to coordinate action among distributed processes? Describe, illustrate and compare two logical clock schemes for filling this gap.

5. Describe how the concepts of consistent linearizations, consistent global states, stable predicates and the snapshot algorithm help to determine if a distributed process has been terminated or is still active.

6. Describe and illustrate the various orders – FIFO, Causal, Total, FIFO-total, Causal-total - in which multicast group members may receive messages. What requirement make a multi-cast message Reliable or Atomic?

7. Describe and illustrate how distributed processes attain Mutual Exclusion of a shared resource.

8. Describe and illustrate how a read-lock is insufficient to ensure the integrity of a read-only query that simply totals the balances of several accounts on the same server.

9. Describe and illustrate how a transaction involving objects on different servers coordinate their actions to protect against a crash failure on one of the participating servers. Include the roles of the client process, the participating processes, the coordinator process and the 2-phase atomic transaction protocol.

10. Describe the steps you took to complete stage 3 of the laboratory project, including the role of RMI (and its components), IIS, FTP, Rclient, ODBC, JDBC and MSAccess.