



Attempt the following questions.

Question 1: (10 Marks)

- (a) Describe and illustrate the client-server architecture of one or more major Internet applications (for example, the Web, email or netnews).
- (b) The Network Time Protocol service can be used to synchronize computer clocks. Explain why, even with this service, no guaranteed bound is given for the difference between two clocks.
- (c) The Internet is far too large for any router to hold routing information for all destinations. How does the Internet routing scheme deal with this issue?

Question 2: (10 Marks)

- (a) How does a newly installed personal computer connected to an Ethernet discover the IP addresses of local servers? How does it translate them to Ethernet addresses?
- (b) Sun XDR aligns each primitive value on a 4-byte boundary, whereas CORBA CDR aligns a primitive value of size n on an n -byte boundary. Discuss the trade-offs in choosing the sizes occupied by primitive values.
- (c) Why can't binary data be represented directly in XML, for example, by representing it as Unicode byte values? XML elements can carry strings represented as *base64*. Discuss the advantages or disadvantages of using this method to represent binary data.

Question 3: (10 Marks)

- (a) Describe a scenario in which a client could receive a reply from an earlier call.
 - (b) Discuss whether the following operations are *idempotent*:
 - i) pressing a lift (elevator) request button;
 - ii) writing data to a file;
 - iii) appending data to a file.
- Is it a necessary condition for idempotence that the operation should not be associated with any state?
- (c) The *Election* service must ensure that a vote is recorded whenever any user thinks they have cast a vote. Discuss the effect of *maybe* call semantics on the *Election* service. Would *at-least-once* call semantics be acceptable for the Election service or would you recommend *at-most-once* call semantics?

Good Luck
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