Tutorial 2 Chapter 2

Question 1

Describe and illustrate the client-server architecture of one or more major Internet applications (for example the Web and email).

Question 2

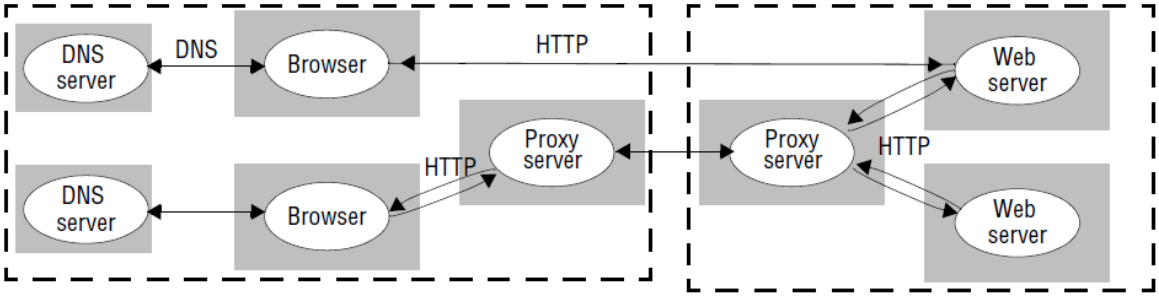
The host computers used in peer-to-peer systems are often simply desktop computers in users' offices or homes. What are the implications of this for the availability and security of any shared data objects that they hold and to what extent can any weaknesses be overcome through the use of replication?

Question 3

The Network Time Protocol service can be used to synchronize computer clocks. Explain why, even with this service, no guaranteed bound given for the difference between two clocks.

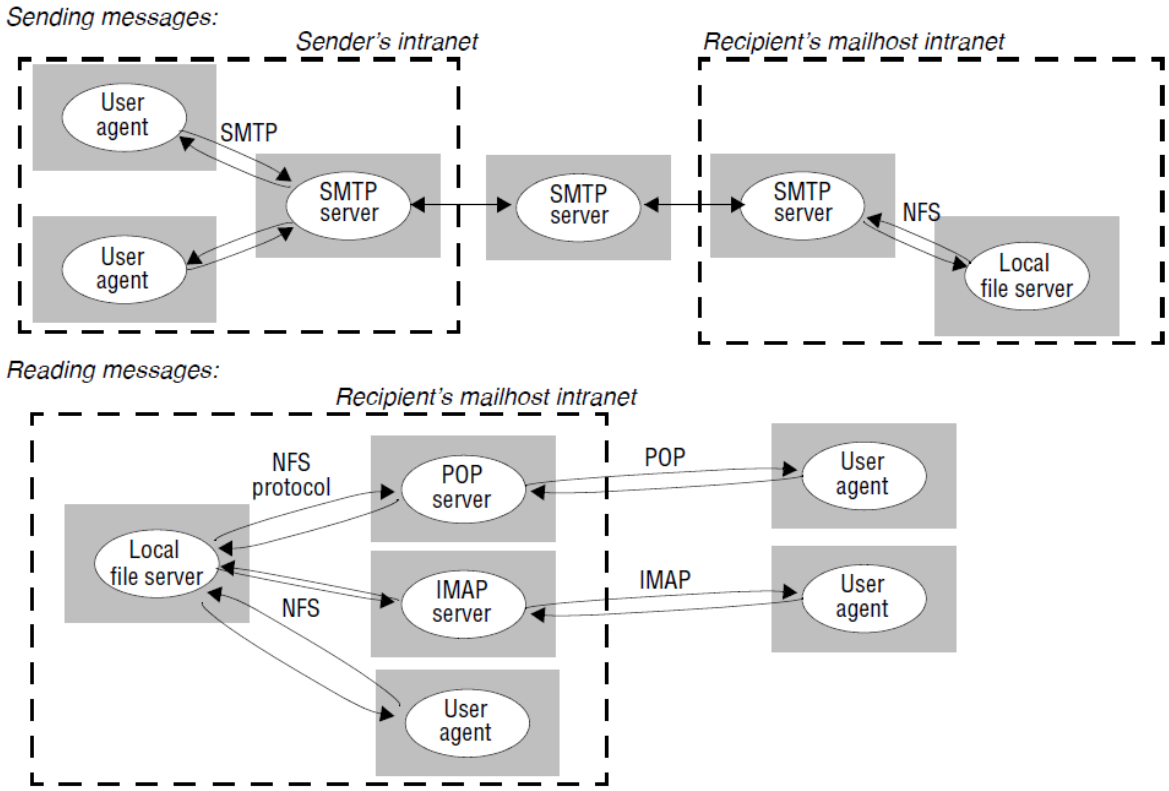
Answer to question 1:

Web:



Browsers are clients of Domain Name Servers (DNS) and web servers (HTTP). Some intranets are configured to interpose a Proxy server. Proxy servers fulfil several purposes – when they are located at the same site as the client, they reduce network delays and network traffic. When they are at the same site as the server, they form a security checkpoint (see pp. 107 and 271) and they can reduce load on the server.
N.B. DNS servers are also involved in all of the application architectures described below, but they ore omitted from the discussion for clarity.

Email:



Sending messages: User Agent (the user's mail composing program) is a client of a local SMTP server and passes each outgoing message to the SMTP server for delivery. The local SMTP server uses mail routing tables to determine a route for each message and then forwards the message to the next SMTP server on the chosen route. Each SMTP server similarly processes and forwards each incoming message unless the domain name in the message address matches the local domain. In the latter case, it attempts to deliver the message to local recipient by storing it in a mailbox file on a local disk or file server.
Reading messages: User Agent (the user's mail reading program) is either a client of the local file server or a client of a mail delivery server such as a POP or IMAP server. In the former case, the User Agent reads messages directly form the mailbox file in which they were placed during the message delivery. (Examples of such user agents are the UNIX mail and pine commands.) In the latter case, the User Agent requests information about the contents of the user's mailbox file from a POP or IMAP server and receives messages from those servers for presentation to the user. POP and IMAP are protocols specifically designed to support mail access over wide areas and slow network connections, so a user can continue to access her home mailbox while travelling.

Answer to question 2:

Problems:

- people often turn their desktop computers off when not using them. Even if on most of the time, they will be off when user is away for an extended time or the computer is being moved.
- the owners of participating computers are unlikely to be known to other participants, so their trustworthiness is unknown. With current hardware and operating systems the owner of a computer has total control over the data on it and may change it or delete it at will.
- network connections to the peer computers are exposed to attack (including denial of service).

The importance of these problems depends on the application. For the music downloading that was the original driving force for peer-to-peer it isn't very important. Users can wait until the relevant host is running to access a particular piece of music. There is little motivation for users to tamper with the music. But for more conventional applications such as file storage availability and integrity are all-important.

Solutions:

Replication:

- if data replicas are sufficiently widespread and numerous, the probability that all are unavailable simultaneously can be reduced the a negligible level.
- one method for ensuring the integrity of data objects stored at multiple hosts (against tampering or accidental error) is to perform an algorithm to establish a consensus about the value of the data (e.g. by exchanging hashes of the object's value and comparing them). This is discussed in Chapter 15. But there is a simpler solution for objects whose value doesn't change (e.g. media files such as music, photographs, radio broadcasts or films).

Secure hash identifiers:

- The object's identifier is derived from its hash code. The identifier is used to address the object. When the object is received by a client, the hash code can be checked for correspondence with the identifier. The hash algorithms used must obey the properties required of a secure hash algorithm as described in Chapter 7.

Answer to question3

Any client using the ntp service must communicate with it by means of messages passed over a communication channel. If a bound can be set on the time to transmit a message over a communication channel, then the difference between the client's clock and the value supplied by the ntp service would also be bounded. With unbounded message transmission time, clock differences are necessarily unbounded.