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Asynchronous communication medium
                                                                                                                                                                 Microsoft Outlook
                                                         User-Agent
                                                                                 Allow user to read, reply to, forward, save and compose messages
                                                                                                                                                                 Apple Mail
                                                                                                                                                                  Thunderbird
Email
                   Three major components
                                                          Mail-servers
                                                                                   Form the core of the email infrastructure
                                                                                   Each recipient has a mailbox located at one of the mailservers
                                                                                                                        Mail server
                                                         SMTP(Simple mail transfer protocols)
                                                                                                            Figure 2.16 ♦ A high-level view of the Internet e-mail system
                                                                                                            Push-protocol
                   Message queue User mailbox
                               Figure 2.17 ◆ Alice sends a message to Bob
               The adventure of a message
                                                      POP3
                   Mail access protocols
                                                      HTTP
                                                                                    Hostname(eg. www.yahoo.com)
                                                                                   IP-Adresses(192.168.0.1)
                                             Hosts: Multiple identifiers
                                                                                   Alias
                                                                            Translate hostname to IP-addresses
                                                                                                     Each host has a canonical hostname, which often is more complicated than the alias
                                                                            Host aliasing
                                             Services provided
                                                                            Mail server aliasing (gives the mailserver hostname from the server hostname (MX-record))
                                                                           Load distribution (One hostname points to many IP-adresses. Gives a shuffled list to client)
                                            A distributed databse implemented in a hierarchy of DNS servers, and
                                            an application-layer protocol that allows hosts to query the distributed database
                                            Often used by other application layer protocols in
                                            order to translate user-supplied hostnames to IP-addresses
                                            Query and reply sent with UDP on port 53
                                                                   Root DNS servers
                                                                                                                 Root DNS servers (.) - Points to TLD server
                                                                    org DNS servers
                                                                                    edu DNS servers
                                                  com DNS servers
DNS (Domain Name System)
                                                                                                                 Top level domain(TLD) servers (.com) - Points to Authoratative domain server
                                                                    pbs.org
DNS servers
                                                                                poly.edu umass.edu
DNS servers DNS servers
                                             yahoo.com
DNS servers
DNS servers
                                                                                                                 Authoratative domain server (responsible for a collection of domains)
                                             Figure 2.19 ♦ Portion of the hierarchy of DNS servers
                                                                                                                 Local DNS server (caches DNS records)
                                                                                                                                                                       Proxy forwarding DNS queries
                                          A distributed, Hierarchical Database
                                            Recursive and iterative requests
                                                                       When a DNS server receives a DNS reply, it can cache the mapping in its local memory.
                                                                       If a hostname/IP adress pair is cahced in a DNS server and another query arrives to the DNS server for the same
                                                                       hostname, the DNS server can provide the desired IP adress, even if it is not authoritative for the hostname.
                                            DNS caching
                                                                       Cached records are discarded after a period of time.
                                                                                                   Format (name, value, type, TTL)
                                            DNS-servers store resource records(RRs)
                                                                                                                                                 Se side 165-166 for mening
                                               Identification
                                                             Number of answer RRs —12 bytes
                                              Number of questions
                                             Number of authority RRs Number of additional RRs
                                                                              Name, type fields for
                                                  Answers (variable number of resource records)
                                                                              RRs in response to query
                                                 Authority (variable number of resource records)
                                                                              Records for
                                           Figure 2.23 • DNS message format
                                          DNS message
                                             Registrar
                 Not server/client
                  Scalability
P2P
                  Can improve distribution time for file transfer
                 Distributed hash table (DHTS)
                                        Torrent: Collection of peers participating in the distribution of a particular file.
                 BitTorrent
                                         (File)Chunks
                                                                  Rarest first
                                        Tracker (Server)
                                                               Choked
                                        Top 4 list
                                                               Unchoked
                                                              1 optimistically unchoked (Random)
                                                     UDP = Datagram
                                                     TCP = Socket
Socket programming
                                                     ServerSocket (Welcome socket)
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Socket (Initializing socket)