COMPUTER SCIENCE TRIPOS Part IB – 2016 – Paper 5

4 Computer Networking (AWM)

Two objects are being retrieved from B by A using HTTP over a network where the TCP-style transport protocol has no maximum segment size and the network experiences no loss. Each object is 125 kByte (i.e., one Mbit) in size. We assume all connection setup packets and HTTP request packets are negligible in size; we ignore the connection tear-down.

(a) Suppose the Round-Trip-Time (RTT) between A and B is 10 milliseconds and the bandwidth between the sites is 10 Mbit/s. Illustrate with a simple diagram in each case how long it takes for A to retrieve both files under the following circumstances: [2 marks each]

   (i) Sequential (one-at-a-time) requests with non-persistent connections.

   (ii) Concurrent requests with non-persistent connections.

   (iii) Sequential requests within a single persistent connection.

   (iv) Pipelined requests within a single persistent connection.

(b) Suppose A is connected to a cache C by a link with 10 Gbit/s bandwidth and negligible RTT. C connects to B with the link originally specified in part (a): 10 Mbit/s and 10 millisecond RTT.

   The cache operates as follows:

   - If the object is not in the cache, the request is forwarded to B which responds with the object, which the cache stores with an object timeout and then forwards to A.

   - If the object is in the cache, and the cache entry has not timed out (i.e., the cache Time To Live (TTL) has not expired), the object is returned to the client.

   - If the object is in the cache, but the cache entry has timed out, the cache issues a conditional GET to the original server, asking if the object has changed since this object was cached. If the original server responds that it has not, the cache returns the cached object, otherwise the original server responds with the updated object which the cache forwards to the client.

   Showing your working, how long does it take for A to retrieve one file under the following circumstances: [3 marks each]

   (i) The file is not in the cache

   (ii) The file is in the cache and the TTL has not expired

   (iii) The file is in the cache, the TTL has expired, but the file has not changed

   (iv) The file is in the cache, the TTL has expired, and the file has changed