CS-3001: Computer Networks

Sessional-II Exam

BS(AI)-(J,K)

Date: 6th April, 2024

Course Instructor

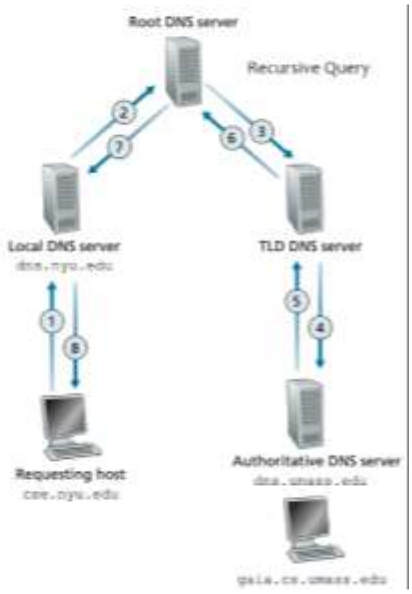
Dr. Abid Rauf

Total Time: 1 Hour
Total Marks: 35

INSTRUCTOR SOLUTION

Q1: DNS RECURSIVE QUERY [07 marks]

Assume that a user is trying to visit gaia.cs.umass.edu, but his browser doesn't know the IP address of the website. In this example, examine the difference between an iterative and recursive DNS query.



a) Between steps 1 and 2, where does the Local DNS server check first? Answer with 'User', 'DNS Local', 'DNS Root', 'DNS TLD', or 'DNS Authoritative'.

DNS Root

b) Between steps 2 and 3, where does the root DNS forward the request to? Answer with 'DNS Local', 'DNS Root', 'DNS TLD', or 'DNS Authoritative'.

DNS TLD server

c) Between steps 4 and 5, where does the authoritative DNS forward the response to? Answer with 'DNS Local', 'DNS Root', 'DNS TLD', or 'DNS Authoritative'.

DNS TLD

d) In steps 6-8, the response is sent back in the reverse direction until it reaches the user. What type of DNS record is returned?

The DNS record received is type A (Type A is hostname:IP)

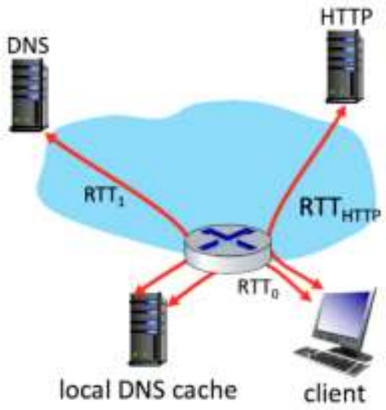
e) Which type of query is considered best practice and why? Iterative or Recursive?

Iterative is considered 'best practice' because it puts less strain on the Root and TLD DNS servers

Q2: DNS AND HTTP DELAYS **[08 marks]**

Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that two DNS servers are visited before your host receives the IP address from DNS. The first DNS server visited is the local DNS cache, with an RTT delay of RTT_0 = 2 msecs. The second DNS server contacted has an RTT_1 of 26 msecs. Initially, let's suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Suppose the RTT between the local host and the Web server containing the object is RTT_{HTTP} = 1 msecs.

a) Assuming zero transmission time for the HTML object, how much time (in msec) elapses from when the client clicks on the link until the client receives the object?



The time from when the Web request is made in the browser until the page is displayed in the browser is: RTT0 + RTT1 + 2* RTT_{HTTP} = 2 + 26 + 2*1 = 30 msecs.
Note that 2 RTT_{HTTP} are needed to fetch the HTML object - one RTT_{HTTP} to establish the TCP connection, and then one RTT_{HTTP} to perform the HTTP GET/response over that TCP connection.

b) Now suppose the HTML object references 5 very small objects on the same server. Neglecting transmission times, how much time (in msec) elapses from when the client clicks on the link until the base object and all 5 additional objects are received from web server at the client, assuming non-persistent HTTP and no parallel TCP connections?

The time from when the Web request is made in the browser until the page is displayed in the browser is: RTT0 + RTT1 + 2* RTT_{HTTP} + 2*5* RTT_{HTTP} = 2 + 26 + 2*1 + 2*5*1 = 40 msecs
Note that two RTT_{HTTP} delays are needed to fetch the base HTML object - one RTT_{HTTP} to establish the TCP connection, and one RTT_{HTTP} to send the HTTP request, and receive the HTTP reply. Then, serially, for each of the 5 embedded objects, a delay of 2* RTT_{HTTP} is needed - one RTT_{HTTP} to establish the TCP connection and then one RTT_{HTTP} to perform the HTTP GET/response over that TCP connection.

c) Suppose the HTML object references 5 very small objects on the same server, but assume that the client is configured to support a maximum of 5 parallel TCP connections, with non-persistent HTTP.

Since there are only 5 objects, there's a delay of 28 msec for the DNS query, two RTTHTTP for the base page, and 2*RTTHTTP for the objects since the requests for these can be run in parallel. The total is 28 + 2 + 2 = 32 msec. As in 2 above, 2 RTTHTTP are needed to fetch the base HTML object - one RTTHTTP to establish the TCP connection, and one RTTHTTP to send the HTTP request and receive the HTTP reply containing the base HTML object. Once the base object is received at the client, the 5 HTTP GETS for the embedded objects can proceed in parallel. Each (in parallel) requires two RTTHTTP delays - one RTTHTTP to set up the TCP connection, and one RTTHTTP to perform the HTTP GET/response for an embedded object.

Q3: Look at the scenario below, where Alice sends an email to Bob. **[8 marks]**

Note: For the questions below, assume both Bob's and Alice's user agents use the POP3 protocol.

a) At point 2 in the diagram, what protocol is being used?

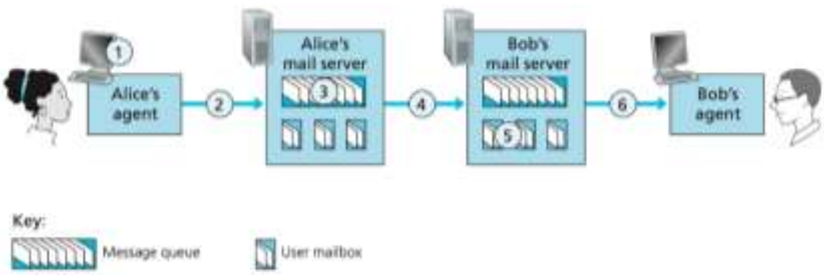
the SMTP protocol is used

b) At point 4 in the diagram, what protocol is being used?

the SMTP protocol is used

c) At point 6 in the diagram, what protocol is being used?

the POP3 protocol is used



d) Does SMTP use TCP or UDP?

TCP protocol

e) Is SMTP a 'push' or 'pull' protocol?

'push' protocol

f) Is POP3 a 'push' or 'pull' protocol?

'pull' protocol

g) What port does SMTP use?

port 25

h) What port does POP3 use?

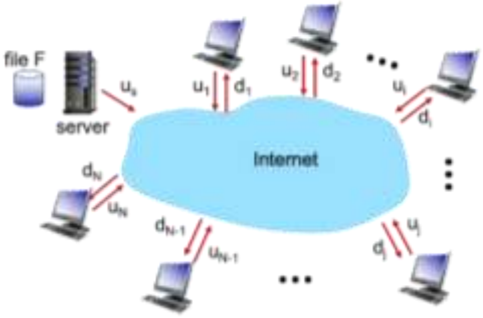
port 110

Q4: In this problem, you'll compare the time needed to distribute a file that is initially located at a server to clients via either client-server download or peer-to-peer download. [5+1+5+1 marks]

The problem is to distribute a file of size F = 4 Gbits to each of these 5 peers. Suppose the server has an upload rate of u = 76 Mbps**.**

The 5 peers have upload rates of: u_1 = 28 Mbps, u_2 = 22 Mbps, u_3 = 24 Mbps, u_4 = 25 Mbps, and u_5 = 27 Mbps

The 5 peers have download rates of: d1 = 22 Mbps, d2 = 29 Mbps, d3 = 14 Mbps, d4 = 11 Mbps, and d5 = 17 Mbps



a) What is the minimum time (in seconds) needed to distribute this file from the central server to the 5 peers using the client-server model? Show complete working.

The minimum time needed to distribute the file = max of: N*F / US and F / dmin = 363.64 seconds.

b) For part a, what is the root cause of this specific minimum time? Answer as 's' or 'ci' where 'i' is the client's number.

The root cause of the minimum time was c4

c) What is the minimum time (in seconds) needed to distribute this file using peer-to-peer download? Show complete working.

The minimum time needed to distribute the file = max of: F / US, F / dmin, and N * F / sum of ui for all i + uS = 363.64 seconds

d) For part c, what is the root cause of this specific minimum time: the server (s), client (c), or the combined upload of the clients and the server (cu)

The root cause of the minimum time was c.