Data Networks WS 18/19

INTERNET ARCHITECTURE:

Assignment 2

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Q1) HTTP

* + Persistent HTTP uses a single TCP connection to send or receive multiple HTTP requests/responses i.e the server leaves the connection to the client open after sending the response. Therefore, subsequent HTTP messages to the same server are sent over the already established open connection.
  + But in non-persistent HTTP, a separate TCP connection to the same server is made for each new connection request! This increases delay in content delivery to even the already connected clients.
  + Web caching is used to temporarily store some of the most accessed data in a way that reduces the delay in content delivery to clients. By using such caches in the client’s browser, ISP, or within a corporate network, delay can be reduced. A content delivery network can also be used to retain copies of some web content and since the CDNs are located closer to end users than the content uploaders, the delay time decreases.
  + No. Web caching will not reduce delay for all objects requested by a user. Any type of live media content will have to be continually updated and the caches will not help. So, in these cases, caching does not help. Also, the TTL for caches that are expected to change are low and after the TTL, they’ll have to be reloaded which reintroduces the delay.

1. Telnet log:

chirag@chirag:~$ telnet google.com 80

Trying 108.177.15.100...

Connected to google.com.

Escape character is '^]'.

GET /images/branding/googlelogo/1x/googlelogo\_color\_150x54dp.png

HOST: www.google.comHTTP/1.0 200 OK

Accept-Ranges: bytes

Content-Type: image/png

Content-Length: 3170

Date: Wed, 31 Oct 2018 22:15:35 GMT

Expires: Wed, 31 Oct 2018 22:15:35 GMT

Cache-Control: private, max-age=31536000

Last-Modified: Thu, 08 Dec 2016 01:00:57 GMT

X-Content-Type-Options: nosniff

Server: sffe

X-XSS-Protection: 1; mode=block

�PNG ……..

**chirag@chirag:~$ telnet google.com 80**

**Trying 108.177.15.101...**

**Connected to google.com.**

**Escape character is '^]'.**

**GET /images/branding/googlelogo/1x/googlelogo\_color\_150x54dp.png HTTP/1.1**

**HOST: www.google.com**

**if-modified-since: Wed, 31 Oct 2018 23:15:00**

**HTTP/1.1 304 Not Modified**

**Date: Wed, 31 Oct 2018 22:17:46 GMT**

**Expires: Wed, 31 Oct 2018 22:17:46 GMT**

Cache-Control: private, max-age=31536000

Last-Modified: Thu, 08 Dec 2016 01:00:57 GMT

X-Content-Type-Options: nosniff

Server: sffe

X-XSS-Protection: 1; mode=block

Q2) DNS

* + A: used for conversion of domain names to IPv4 addresses. A specific “A” record specifies the IPv4 address for a given host.
  + AAAA: used for conversion of domain names to IPv6 addresses. A specific “AAAA” record specifies the IPv6 address for a given host.
  + CNAME: This record is an alias of our domain name to send the query to an external domain name maybe in content distribution network that is closer to the end user.
  + NS: These records identify the DNS servers responsible for a zone and is mostly used for zone transfer.
  + MX: This record is an entry in the DNS zone file which specifies a mail server to handle a domain’s email.
  + google.in

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| --- | --- |
| Local (IPv4) | ;; ANSWER SECTION:  google.in.       300    IN A   74.125.143.104  google.in.       300    IN A   74.125.143.147  google.in.       300    IN A   74.125.143.106  google.in.       300    IN A   74.125.143.99  google.in.       300    IN A   74.125.143.105  google.in.       300    IN A   74.125.143.103    ;; Query time: 80 msec  ;; SERVER: 127.0.1.1#53(127.0.1.1)  ;; WHEN: Wed Oct 31 17:45:21 CET 2018  ;; MSG SIZE  rcvd: 134 |
| 8.8.8.8 (IPv4) | ;; ANSWER SECTION:  google.in.       299    IN A   172.217.18.4    ;; Query time: 32 msec  ;; SERVER: 8.8.8.8#53(8.8.8.8)  ;; WHEN: Thu Nov 01 00:42:47 CET 2018  ;; MSG SIZE  rcvd: 54 |
| Local(IPv6) | ;; ANSWER SECTION:  google.in.       300    IN AAAA    2a00:1450:4013:c07::67    ;; Query time: 61 msec  ;; SERVER: 127.0.1.1#53(127.0.1.1)  ;; WHEN: Wed Oct 31 23:54:45 CET 2018  ;; MSG SIZE  rcvd: 66 |
| 8.8.8.8(IPv6) | ;;; ANSWER SECTION:  google.in.       299    IN AAAA    2a00:1450:4001:80b::2004    ;; Query time: 33 msec  ;; SERVER: 8.8.8.8#53(8.8.8.8)  ;; WHEN: Wed Oct 31 23:55:38 CET 2018  ;; MSG SIZE  rcvd: 66 |

1. By querying duckduckgo.com a few times, we can see that the IP address of the domain changes each time i.e it is dynamic.

The ISP assigns dynamic IP addresses to users as it is more convenient for the ISP. But this creates the problem of remembering many IP addresses which keep continuously changing. In this scenario, Dynamic DNS name can be used. Now the users only need to know the DNS names and the Dynamic DNS will map the domain name to the dynamic IP address and the users will not have to worry about knowing the dynamic IP address.

1. The client accessing the website will get an error on the browser and then he can manually retry to establish the connection or the application layer can be made to resend a connection request in case of a timer running out without a connection being established.

Q3) CDN

1. www.audi.de

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| --- | --- |
| local | ;; ANSWER SECTION:  www.audi.de.       260    IN CNAME    www.audi.de.edgekey.net.  www.audi.de.edgekey.net. 9385    IN CNAME e9504.c.akamaiedge.net.  e9504.c.akamaiedge.net.    20 IN A 104.90.138.187    ;; Query time: 38 msec  ;; SERVER: 127.0.1.1#53(127.0.1.1)  ;; WHEN: Thu Nov 01 00:35:39 CET 2018  ;; MSG SIZE  rcvd: 126 |
| 202.58.192.10 | ;; ANSWER SECTION:  www.audi.de.       430    IN CNAME    www.audi.de.edgekey.net.  www.audi.de.edgekey.net. 16990    IN CNAME e9504.c.akamaiedge.net.  e9504.c.akamaiedge.net.    20 IN A 104.88.252.34    ;; AUTHORITY SECTION:  c.akamaiedge.net.    1871 IN NS n1c.akamaiedge.net.  c.akamaiedge.net.    1871 IN NS n6c.akamaiedge.net.  c.akamaiedge.net.    1871 IN NS n5c.akamaiedge.net.  c.akamaiedge.net.    1871 IN NS n0c.akamaiedge.net.  c.akamaiedge.net.    1871 IN NS n4c.akamaiedge.net.  c.akamaiedge.net.    1871 IN NS n2c.akamaiedge.net.  c.akamaiedge.net.    1871 IN NS n3c.akamaiedge.net.  c.akamaiedge.net.    1871 IN NS n7c.akamaiedge.net.    ;; ADDITIONAL SECTION:  n4c.akamaiedge.net.    1728 IN A 114.4.168.13  n1c.akamaiedge.net.    1728 IN A 114.4.168.30  n0c.akamaiedge.net.    1728 IN A 88.221.81.192  n0c.akamaiedge.net.    1728 IN AAAA 2600:1480:e800::c0  n6c.akamaiedge.net.    1728 IN A 114.4.168.68  n3c.akamaiedge.net.    1728 IN A 23.0.162.54  n5c.akamaiedge.net.    1728 IN A 23.0.162.50  n2c.akamaiedge.net.    1728 IN A 23.0.162.49  n7c.akamaiedge.net.    1728 IN A 119.110.115.151    ;; Query time: 332 msec  ;; SERVER: 202.58.192.10#53(202.58.192.10)  ;; WHEN: Thu Nov 01 00:38:35 CET 2018  ;; MSG SIZE  rcvd: 426 |

1. When dig is used on [www.audi.de](http://www.audi.de) directly using our local DNS, we have a very short round trip time and the location of the IP address is somewhere close by in Germany itself. But when we use the public DNS server in Indonesia, the RTT increases significantly! This is because we are trying to access the website in a roundabout way. Regardless, through the public Indonesian DNS server, we enter the Akamai network which tries to find a cached copy of [www.audi.de](http://www.audi.de) in one of its servers near to the Public Indonesian DNS server. Therefore, the CDN chooses an appropriate replica based on RTT w.r.t the DNS server from which the request arises.
2. The CDN uses the CNAME to point to a server which might have the required cached copy. If this sever doesn’t have the information, it will use another CNAME to do the same. Therefore, the CDN uses the CNAME to lead the user to some cached data which is much closer to the user than the actual content provider.
3. The TTL for A records is much lesser than the TTL for CNAME records. This is because the A records may represent dynamic IP addresses which will have to be updated quite frequently while the CNAME records represent actual human readable domain names which are not as frequently changed.

Q4) Secure Shell

1. It is an application layer protocol for operating network services securely over an unsecured network. SSH uses public-key cryptography as a means of authentication. Automatically generated public-private key pairs can be used for encrypting the network and a password can be used to allow only authenticated users. Or a manually generated public-private key pair can be used without a password.
2. SSH uses the TCP protocol at transport layer.
3. Yes, standardized. Standard is RFC 4253.