527 — Computer Networks and Distributed Systems — Transport Layer and Application Layer

Note that the solution notes below only briefly list (some of) the key points that should be included in an answer. They are by no means complete. In an exam, you are expected to spell out the solution more fully and include a detailed explanation of your reasoning.

TCP vs. UDP

Give an example of a network service or application that uses

1. UDP
2. TCP

Include in each case why the transport protocol used is appropriate for the requirements.

1. DNS, DHCP, some VoIP applications, video streaming, network file system (NFS), ... (real-time or small, transactionless interactions)
2. HTTP, FTP, SMTP, SSH, Telnet, ... (mostly long-lived, reliable stream connections)

Multiple Connections

If a host has multiple TCP connections to the same service on another host how is the separation of connections maintained?

- A connection has 5 elements:
  `(protocol, source IP, source port, destination IP, destination port)`.
- For different connections to the same service the source ports will differ.

UDP and ICMP

Assume a UDP datagram is sent from host A, port P, to host B, port Q, but at host B there is no process listening to port Q. In this given scenario, B is to send back an ICMP "Port Unreachable" message to A. Like all ICMP messages, this is addressed to A as a whole, not to port P on A.

1. Give an example of when an application might want to receive such ICMP messages.
2. Why might it not be a good idea to send such messages directly back to the originating port P on A?
3. How does the situation change when TCP is used instead of UDP?

1. An application may want to find out about this error to alert the user.
2. The process that originally sent the UDP packet may not be listening to this port any more.
3. TCP notices the failure during connection establishment, so does not need to rely on ICMP packets.

Question: URLs and Network Services

1. What information does the URL `http://www.phdcomics.com:80/comics.php` give?
2. What needs to happen before the document referred to by the URL above can be displayed?

1. `http` = use HTTP protocol
   `www.phdcomics.com` = name of host
   `:80` = use port 80 (web)

`/comics.php` = name of resource on host
`.php` suggests dynamically generated content by a PHP script

2. DNS client resolves the host name to an IP address. Using the IP address, port number, and name/path of resource, a client (e.g. web browser) uses HTTP to requests the resource and displays the content based on the MIME type, length, and other meta data in the HTTP response header.

ARP vs. DNS Caching

ARP and DNS both depend on caches. The lifetimes of ARP cache entries are typically in the order of a few minutes, while for DNS they are in the order of hours or days. Justify this difference. What are the undesirable consequences of too long lifetimes of DNS caches?

- It usually takes less time to move machines than register new hostnames.
- It would take longer to migrate an IP address of a publicly advertised hostname to a different IP address. Traffic would still be sent to the old IP address until cached entries have been updated.

Domain Names vs. IP Addresses

What is the relationship between a domain name (e.g. `doc.ic.ac.uk`) and an IP subnet (e.g. `146.169.24.0/22`)?

- There is no direct relationship except that both types are hierarchical.

Using a Web Browser

Consider a web browser that wants to retrieve a web page at a given URL. The IP address of the web server is initially unknown. What network-, transport- and application-layer protocols are needed in this scenario?

- Consider the roles that TCP, UDP, ARP, DNS and HTTP play here.