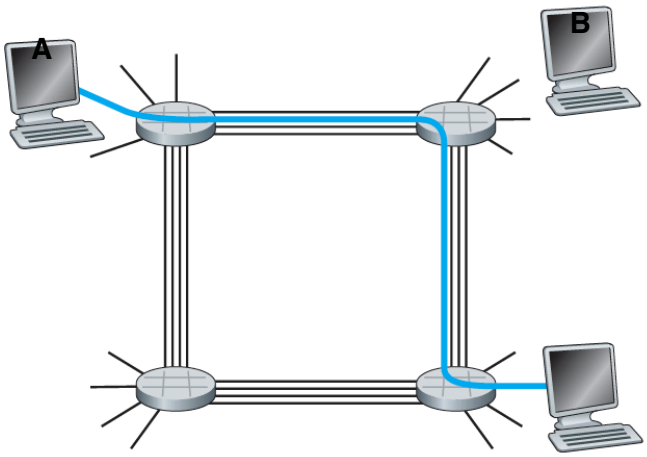
Michael Cabana
27527489

TA1: Introduction to the Application Layer

Q1: It is advantageous to organize network protocols in layers because it allows for explicit structure and identification of relationships of complex systems. It also allows for easy maintenance and updating of parts of the system. A drawback is that one layer may duplicate lower-layer functionality. A second drawback is that functionality at one layer may need information that is located in another layer which violates the goal of separation.

Q2: Bandwidth is the raw capability of a system to move data through a communication channel at its most optimal whereas throughput is the actual measurement of data moving through a system based on its capabilities. Throughput can never be higher than bandwidth because essentially bandwidth is the highest possible throughput a system can send data. An example of this is a highway. Bandwidth would be the maximum amount of cars that can travel on this highway at any given time but throughput would be how many cars can actually use the highway given it's capability. Things like lane closures, accidents, construction, etc. would affect throughput.

Q3: Yes, it is possible that circuit switching can end up hurting its users. Using the example graphic below, lets say computer B represents 4 devices. If Computer A wishes to communicate with those 4 devices at the same time, then 4 communication links would be used. Since there



are only 4 links per circuit switcher, no other connections by any other device or to more devices would be possible. Also, since each link has 4 circuits, dedicated transmission rate is limited to one fourth the total transmission rate.

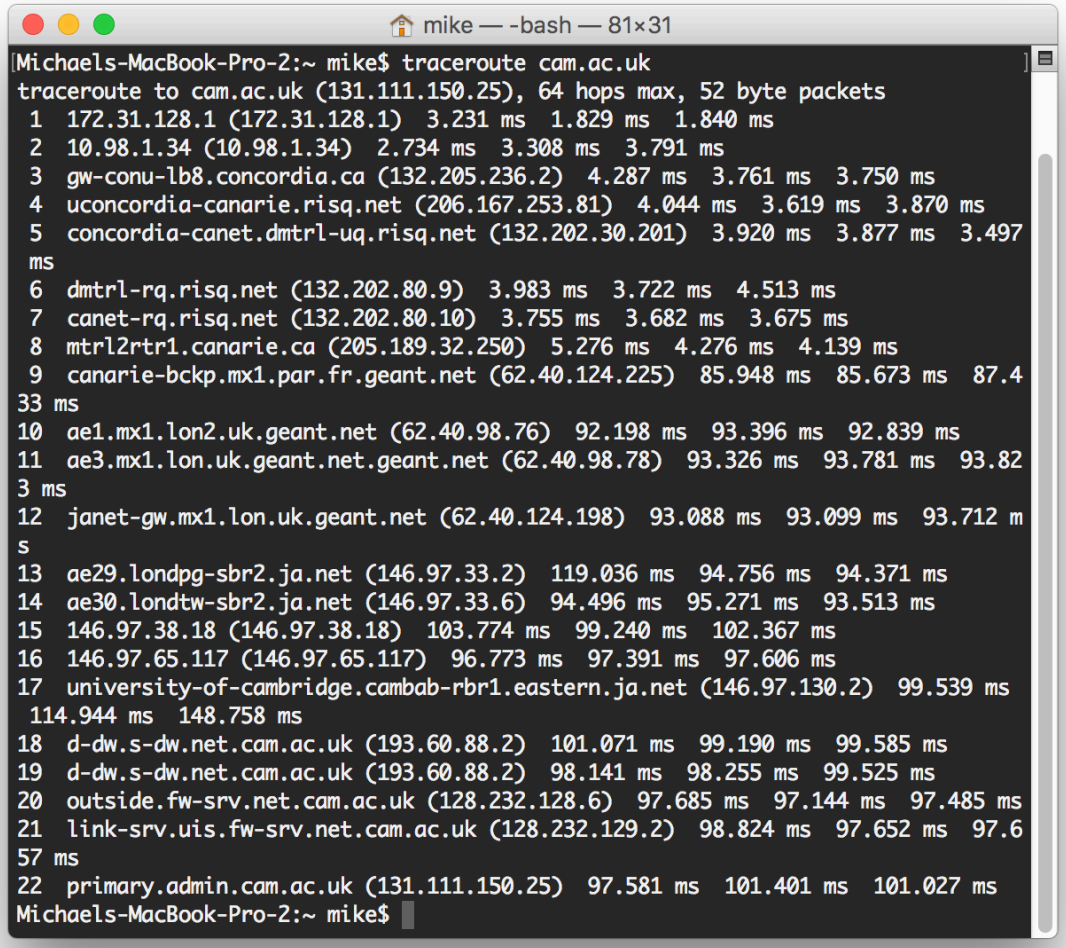
Q4:

1. Propagation delay = d/s = (10,000 x 10^3)/(2.5x10^8) = 0.04 s
2. Transmission delay for 8 packets = L/R = (2 Mb x 8)/5 Mbps = 16 Mb/5 Mbps = 3.2 s

Q5:

1. Propagation delay = P(R1) + P(R2) = (5,000 x 10^3)/(2.5x10^8) + (5,000 x 10^3)/(2.5x10^8) = 0.04 s.
2. Transmission delay = T(R1) + T(R2) = (2 Mb/4 Mbps + 2 Mb/6 Mbps) x 8 = 6.666666667 s

Q6: I performed a **traceroute** for the Cambridge University web site cam.ac.uk.



There does not appear to be anything unusual with the returned results although at line 15 and 16, those IP addresses did not resolve to domain names. In total there were 22 routes in between my machine and the target.

Q7: The Mirai malware targets Linux systems, specifically devices like remote cameras and home routers turning them into bots and thereby creating a botnet. The botnet is then used to attack internet hosts by means of DDoS attacks in which a host is bombarded with packets thereby denying service to actual users and rendering the host useless.

Q8: To retrieve a web page, the browser client first needs to find out the IP of the domain so it does a DNS request over UDP. Once the IP is known, a HTTP GET request is done over TCP to retrieve the relevant web page. So the Application Layer protocols are HTTP and DNS and the Transport Layer protocols are TCP and UDP.

Q9: Alice's email will remain in Alice's mail server message queue until Bob's mail server is back up and able to retrieve it. Alice's mail server will retry to send the email every 30 mins for a few days. If by then Bob's server is not back up, the server removes the message from the queue and notifies Alice.

Q10:

Des = max { NF/us , F/dp }

Dp2p = max { F/us , F/dp, NF/ (us + sum1toN(ui))

file size F = 15 Gbits * 1024 = 15360 Mbits
peers N = 10,100, 1000
server upload rate us = 30Mbps
peer download rate dp = 2Mbps
peer upload rate up = 300, 700, 2000 Kbps

Client Server

up / N	10	100	1000
300 Kbps	7680	51200	512000
700 Kbps	7680	51200	512000
2 Mbps	7680	51200	512000

Peer to Peer

up / N	10	100	1000
300 Kbps	7680	25600	46545.45455
700 Kbps	7680	15360	21041.09589
2 Mbps	7680	7680	7680