

Section 13: Networking

CS 162

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1 Vocabulary

- **TCP** - Transmission Control Protocol (TCP) is a common L4 (transport layer) protocol that guarantees reliable in-order delivery. In-order delivery is accomplished through the use of sequence numbers attached to every data packet, and reliable delivery is accomplished through the use of ACKs (acknowledgements).

2 Networking

- a) (True/False) IPv4 can support up to 2^{64} different hosts.

- b) (True/False) Port numbers are in the IP header.

- c) (True/False) UDP has a built in abstraction for sending packets in an in order fashion.

- d) (True/False) TCP provide a reliable and ordered byte stream abstraction to networking.

- e) (True/False) TCP attempts to solve the congestion control problem by adjusting the sending window when packets are dropped.

- f) In TCP, how do we achieve logically ordered packets despite the out of order delivery of the physical reality? What field of the TCP packet is used for this?

- g) Describe the semantics of the acknowledgement field and also the window field in a TCP ack.

- h) List the 5 layers specified in the TCP/IP model. Layering adds modularity to the internet and allows innovation to happen at all layers largely in parallel. What is the function of each layer?

i) The end to end principle is one of the most famed design principles in all of engineering. It argues that functionality should **only** be placed in the network if certain conditions are met. Otherwise, they should be implemented in the end hosts. These conditions are:

- Only If Sufficient: Don't implement a function in the network unless it can be completely implemented at this level.
- Only If Necessary: Don't implement anything in the network that can be implemented correctly by the hosts.
- Only If Useful: If hosts can implement functionality correctly, implement it in the network only as a performance enhancement.

Take for example the concept of reliability: making all efforts to ensure that a packet sent is not lost or corrupted and is indeed received by the other end. Using each of the three criteria, argue if reliability should be implemented in the network.

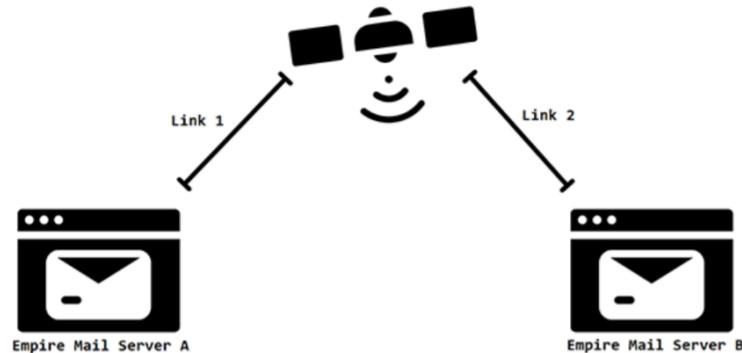
i) Only If Sufficient

ii) Only If Necessary

iii) Only If Useful

3 SP21 MT3 Stardust

Grand Moff Tarkin wants to send the blueprints over interstellar satellite connections, from Empire Mail Server A to Empire Mail Server B. Empire Mail Server A's connection to the satellite is denoted Link 1, while Empire Mail Server B's connection to the satellite is denoted Link 2.



Assume the following information:

- 120 ms latency from either server to the satellite, and vice versa (both Link 1 and Link 2)
- 10 ms latency for the router machinery within the satellite; assume that the router can process packets at full line rate (i.e. as fast as needed by the network)
- Maximum Transfer Unit of 1,000 B (both Link 1 and Link 2)
- Bandwidth over Link 1: 200 GiB/s
- Bandwidth over Link 2: 250 GiB/s
- TCP/IP Header size: 50 B

Note that the bandwidth is given in GiB/s for convenience, instead of Gb/s, which would typically be used.

1. Assuming that Empire Mail Server A and Empire Mail Server B are communicating via a mail-transfer protocol carried over TCP/IP, what is the maximum sustained communications bandwidth (excludes overhead) that the two servers could achieve over the satellite connection?

2. Assuming that Empire Mail Server A and Empire Mail Server B are communicating via a mail-transfer protocol carried over TCP/IP. Based on the given assumptions, what is the Round Trip Time (RTT) for a 512 B packet?

