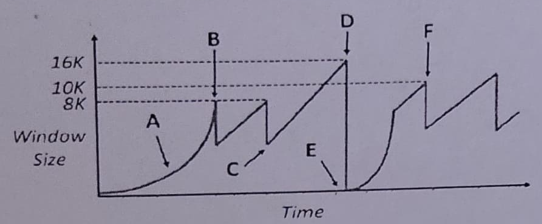
Birla Institute of Technology & Science, Pilani
Department of Computer Science and Information Systems
First Semester 2025-26
Advanced Computer Networks (CS G525)
MID SEMESTER TEST (CLOSE BOOK)

Duration: 1.5 Hrs. **Date: 07-10-2025** 11:00 – 12:30 PM **MM: 25**

Note: Answer sub-parts of a question (if any) at one place in the sequence.

Q.1 a) Suppose we use AIMD algorithm with the same multiplicative decreasing factor (b_D) for both User 1 and User 2, but User 1's additive increasing factor (a_I) is half the additive increasing factor of User 2. Show the resource allocation convergence process with the help of a two-phase plot, following the format we discussed in the class. Calculate the fairness for the algorithm.

b) Answer the following questions based on the TCP connection plot of Window Size (in kilobytes) versus Time. Please make a note that the plot is NOT DRAWN TO SCALE. Assume K = 1000 Bytes. [1.5 + 3.5 = 5M]



i) Does the event at point B necessarily indicate that a packet was discarded by the network? Explain.

ii) Assume that the network has an MSS of 1000 bytes and the RTT between sender and receiver of 100 milliseconds. Assume at time 0 the sender attempts to open the connection. Also, assume that the sender can "write" a full window's worth of data instantaneously. How much time has elapsed by point B since the connection was opened? Show your calculations.

iii) How much time has elapsed between points E and F?

iv) Compute the average TCP window size (in MSS) from the start of the connection up-to point D.

Q.2 Three participants (A, B, and C) are running the *ChronoSync* protocol in an NDN-based collaborative application. Initially, all have the same dataset with 4 data items (D1, D2, D3, D4). The digest of the dataset is represented as a hash of all current items. [1.5 + 1.5 + 1 = 4M]

1. At time *t1*, Participant A publishes a new data item D5.
2. At time *t2*, Participant B publishes two new items D6 and D7.
3. At time *t3*, Participant C comes online after being offline since *t0* (before D5, D6, and D7 were generated).

a) Show how the *ChronoSync* digests evolve at each step for participants A, B, and C.

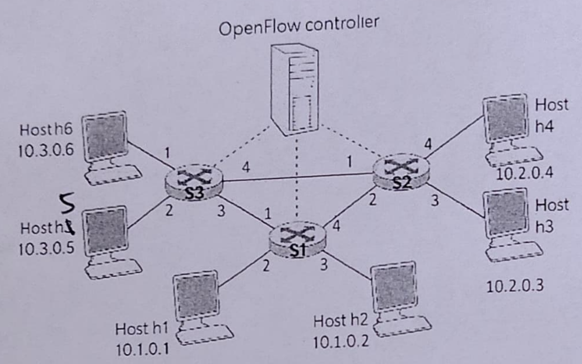
b) Describe how synchronization messages are exchanged so that all participants eventually converge to the same dataset.

c) Calculate the minimum number of Interest and Data exchanges required for C to synchronize with A and B after rejoining.

Q.3 The network topology shown below consists of three OpenFlow switches (**S1, S2, S3**) and six hosts (**h1 to h6**). The numbers indicated on the links correspond to the port numbers of the switches. Which flow entries need to be installed on switches S1 and S3 to enforce the following traffic rules, arranged in descending order of priority? Assume single Flow Table for each switch. [5M]

1. Traffic from h5 to h3 must be routed through switch S1, while the traffic from h5 to h4 should follow the shortest path.
2. Switch S1 must forward all traffic destined for h3 or h4 via switch S3.
3. The HTTPS server runs on Host h1 is accessible within its subnetwork (10.1.0.0/16). Hosts outside this subnetwork must be blocked from accessing the HTTPS server. Host h1 should only receive HTTPS traffic; all other traffic must be blocked.

All remaining traffic flows not covered by the above rules should follow shortest path.



Q.4 Suppose two long-lived TCP flows share a 1 Gbps bottleneck link with an RTT of 100 milliseconds. The Flow A uses TCP CUBIC and Flow B uses TCP BBR v1 [2 +1.5 + 1.5 = 5M]

a) Explain how each congestion control algorithm determines its sending rate and reacts to packet loss.

b) Predict the relative throughput share between the two flows under the following conditions:

i) Low random packet loss (0.001%)
ii) Moderate random packet loss (0.1%)
iii) High random packet loss (5%)

c) Discuss the fairness implications when BBR v1 competes with CUBIC. Why might one protocol dominate the other?

Q.5 Answer the following questions. [2 + 1.5 + 2.5 = 6M]

a) Why does HTTP/2 with QUIC over UDP offer better web performance compared to HTTP/2 with TLS over TCP? Explain.

b) In the paper *"Fabric: A Retrospective on Evolving SDN"*, the authors propose a layered architecture in which the host-network interface is restricted to the network edge, while the general packet-switch interface is confined to the network core. How does this architectural shift within the SDN framework align with the ideal requirements of a network? Briefly explain.

c) Consider an ongoing TCP flow between client A and server B.

i) If client A moves to a new network, what causes the TCP session to fail?
ii) Which Internet design principle is violated, leading to the lack of connection-oriented mobility? Justify.
iii) How does the Named Data Networking (NDN) architecture provide support for node mobility? Explain.

xx—00—xx