Computer Networks – Lab 07 (NS3) Quick Revision Sheet

Lab Objectives

• Introduction to NS3 Network Simulator

• Simple Network Simulation in NS3

• Implementation of TCP Congestion Control and Simulation

NS3 Overview (Roman Urdu Explanation)

NS3 ek network simulator hai jo networking research aur education ke liye use hota hai. Yeh ek virtual environment banata hai jahan hum different protocols (TCP, UDP, Routing) aur network topologies simulate kar sakte hain bina real devices ke.

Point-to-Point Link

Point-to-point link ka matlab hai ek direct connection do nodes ke beech – jaise ek wire jo sirf do computers ko connect karti hai. NS3 mein isko PointToPointHelper se define karte hain, jahan hum DataRate (speed) aur Delay set karte hain.

Key Components in NS3 Script

- NodeContainer – virtual nodes (computers) banata hai
- PointToPointHelper – wired link banata hai between nodes
- InternetStackHelper – TCP/IP stack install karta hai nodes pe
- Ipv4AddressHelper – IP addresses assign karta hai
- UdpEchoServer/ClientHelper – client-server communication simulate karta hai
- Simulator::Run() aur Simulator::Destroy() – simulation start aur end karte hain

TCP Congestion Control Mechanism

- Slow Start – CWND (Congestion Window) exponential tarike se badhta hai (1,2,4,8...)
- Congestion Avoidance – CWND linear growth par chala jata hai jab ssthresh cross karta hai
- Congestion Detection – Jab packet loss hoti hai to CWND half ho jata hai (multiplicative decrease)

TCP Variants

• TCP Tahoe – Packet loss ke baad CWND = 1 kar deta hai, slow start se restart karta hai. • TCP Reno – Fast Recovery use karta hai, CWND = ssthresh (half) kar deta hai. • TCP NewReno/Cubic – Reno ke improved versions hain, performance zyada stable hoti hai.

Possible Exam Questions

- NS3 kya hai aur iska purpose kya hai?
- Point-to-point link kya hota hai aur NS3 mein kaise banate hain?
- NodeContainer aur PointToPointHelper ka role kya hai?
- TCP Congestion Control ke 3 phases samjhao.
- TCP Tahoe aur Reno mein farq kya hai?

Practical / Code-based Tasks

- Change DataRate or Delay in PointToPoint link
- Add an extra node in network
- Change Packet Size or Interval for client
- Enable Animation trace using NetAnim
- Implement TCP instead of UDP
- Plot TCP Congestion Window graph (using built-in or custom code)

Steps to Apply TCP Congestion Control and Plot CWND Graph

- 1. Open terminal and go to ns-3 directory.
- 2. Run built-in example: ./waf --run 'tcp-variants-comparison --transport_prot=TcpNewReno --tracing=1'
- 3. Output trace file (e.g., cwndTraceNewReno) generate hoga.
- 4. Use Gnuplot to plot graph:
- gnuplot> plot 'cwndTraceNewReno' using 1:2 with linespoints title 'CWND Graph'
- 5. Alternatively, apna custom C++ script likh kar cwnd_trace.txt log karo aur plot banao.

Tip: Exam mein code modification type questions aayenge, so commands aur attributes yaad rakho.