# QCN 2-point Architecture with Shared Rate Limiters, Multipathing

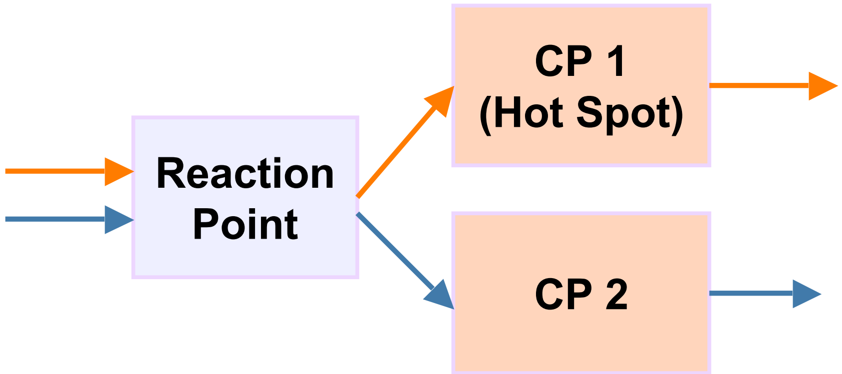
**Abdul Kabbani, Ashvin Lakshmikantha, Rong Pan, Balaji Prabhakar, Mick Seaman**

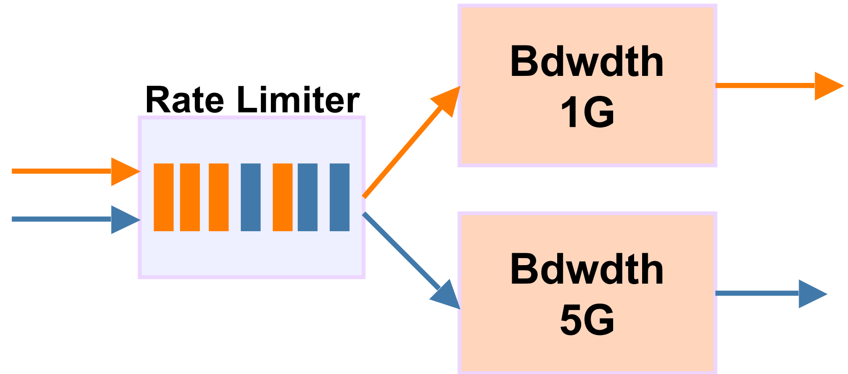
# Outline of presentation

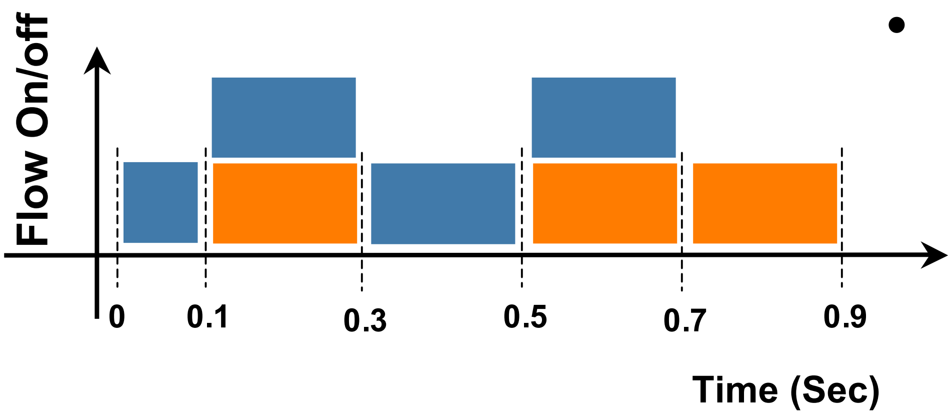
- Simulation study of flows sharing a rate limiter under the 2-point architecture
- Steady loading (infinitely long-lived)
  - Two flows, 1 rate limiter, two paths

    (To be done: Dynamic flows, flow completion time)
- Discussion of 3-point architecture

# Basic Scenario

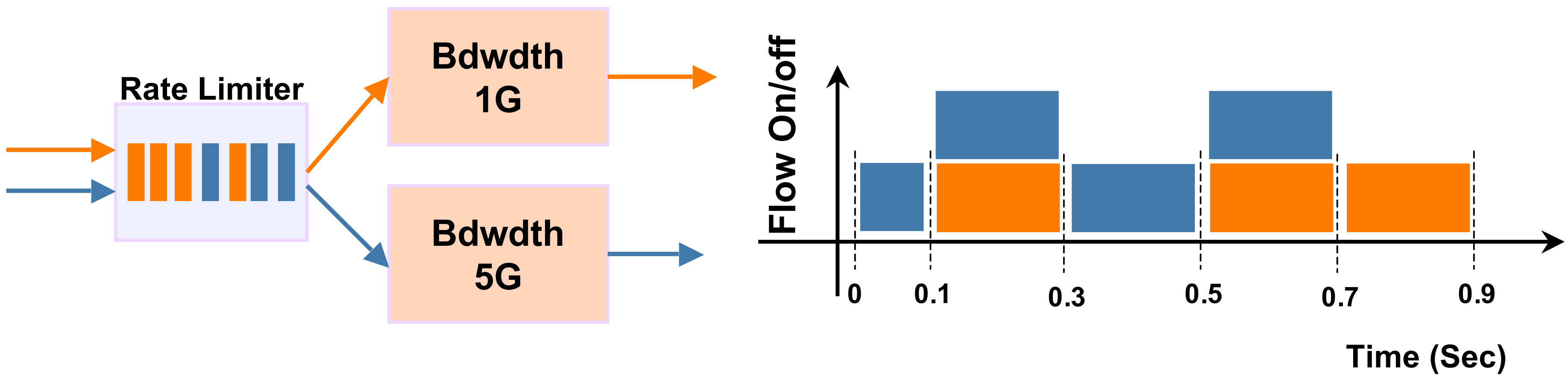


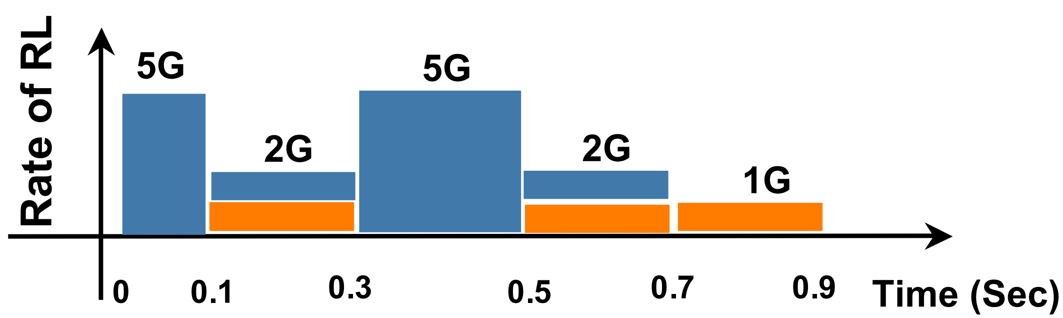




- Loading pattern
  - Timing diagram on left shows how the flows are applied
  - When only one flow is present, all packets in RL belong to it
  - When both flows are present, the distribution of packets can either be
    - Bernoulli; e.g. 1:1 (50-50%) for each flow
    - Round robin; e.g 1:1 deterministic interleaving
    - We also have other mixes: 1:5, 1:9

# QCN 2-Point Architecture
# Bernoulli 1:1; Bdwdth: 1G, 5G



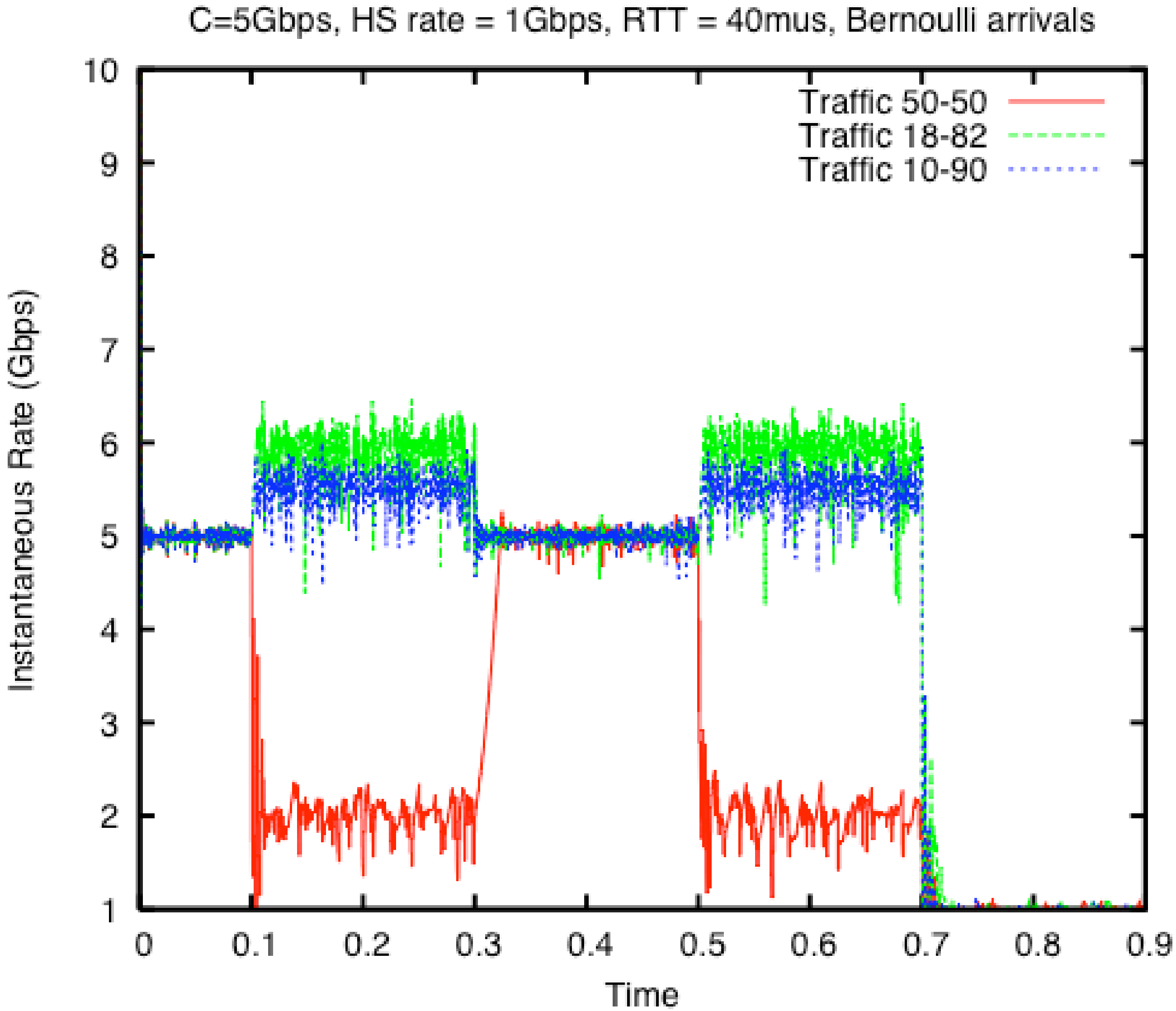




- Ideal rate of RL under QCN 2-point architecture shown above for traffic mix 1:1.

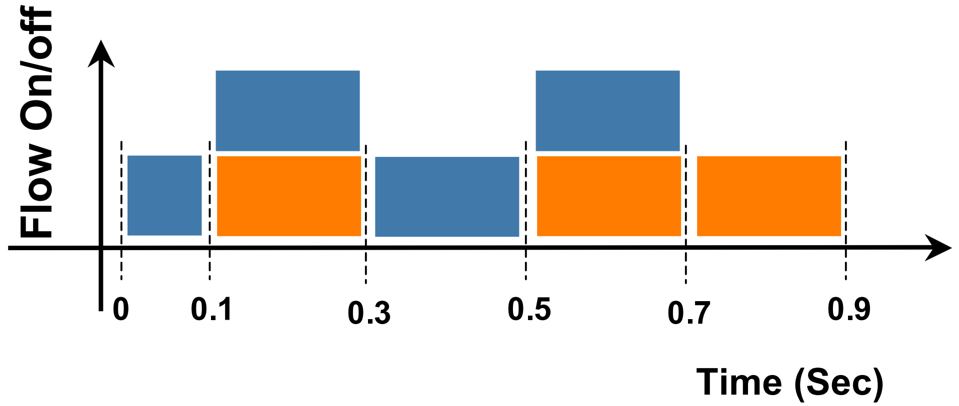
# Simulation parameters

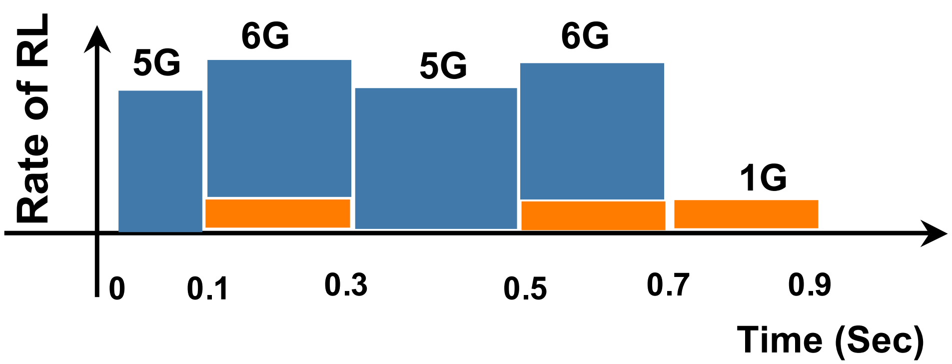
- 2 flows, 1 RL, 2 paths
  - Timing diagram of flows as shown earlier
  - Link delay (RTT): 40 microseconds
  - Gd = 1/128
  - w = 2
  - Ri = 12 Mbps
  - Drift: X = 1.005, T = 500 musecs
  - Sampling function = linearly increases with lFbl from 1--10%
  - Buffer size = 100 pkts (pkt length = 1500 bytes)

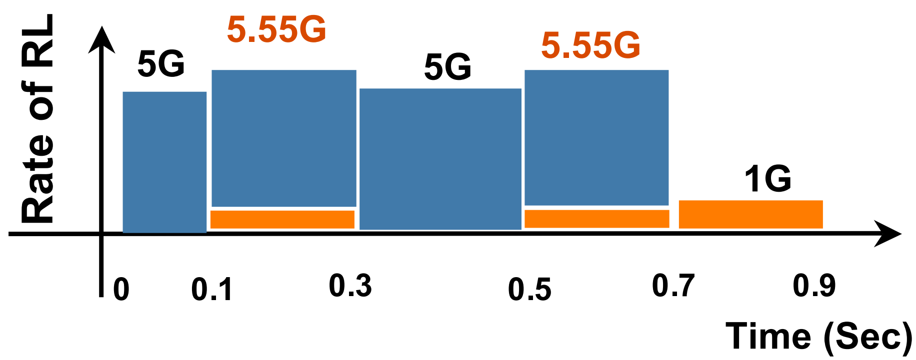
# Bernoulli 1:1; Bdwdth: 1G, 5G
# Rate of RL



# QCN 2-Point Architecture
# Bernoulli 1:5, 1:9; Bdwdth: 1G, 5G

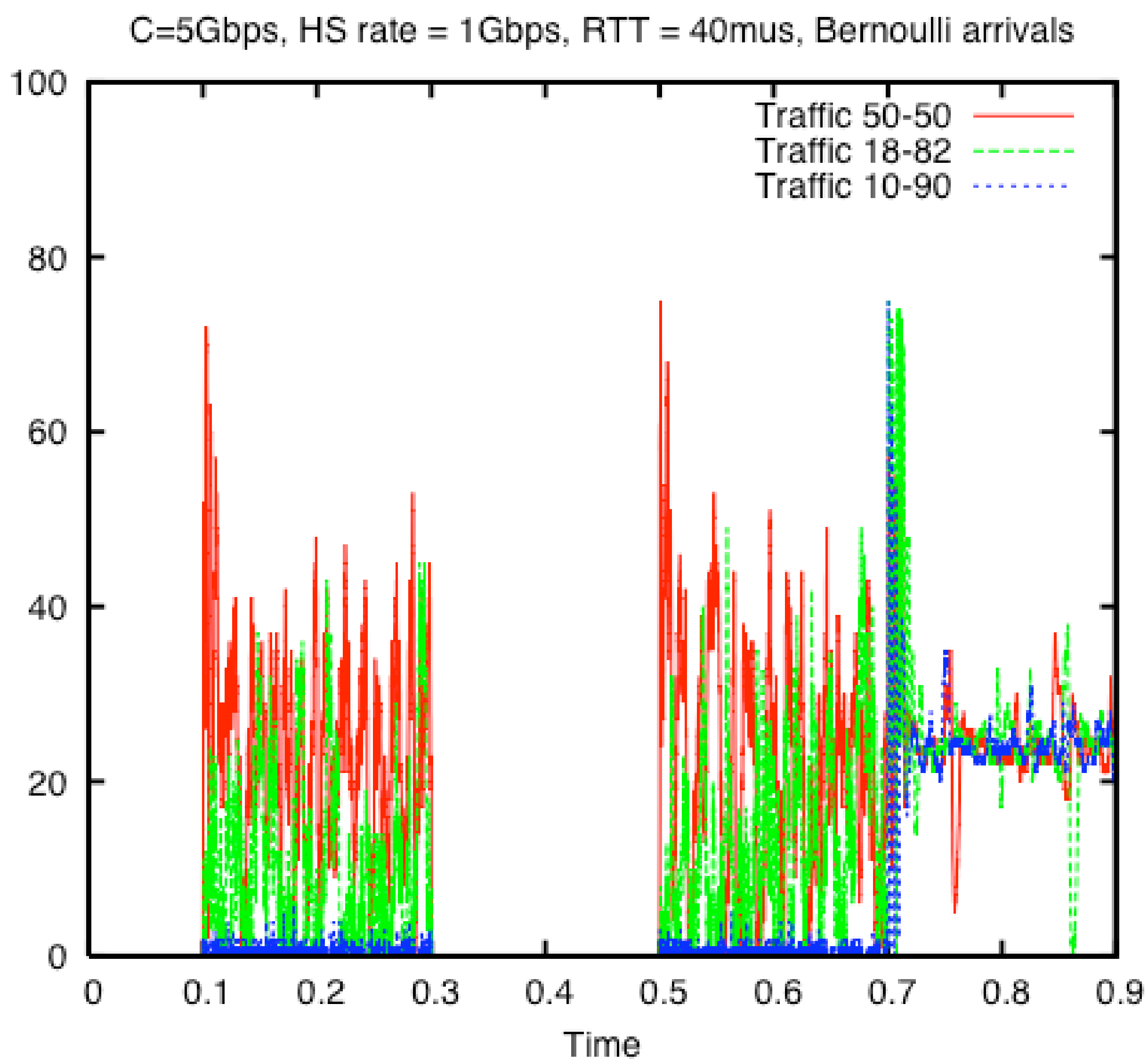


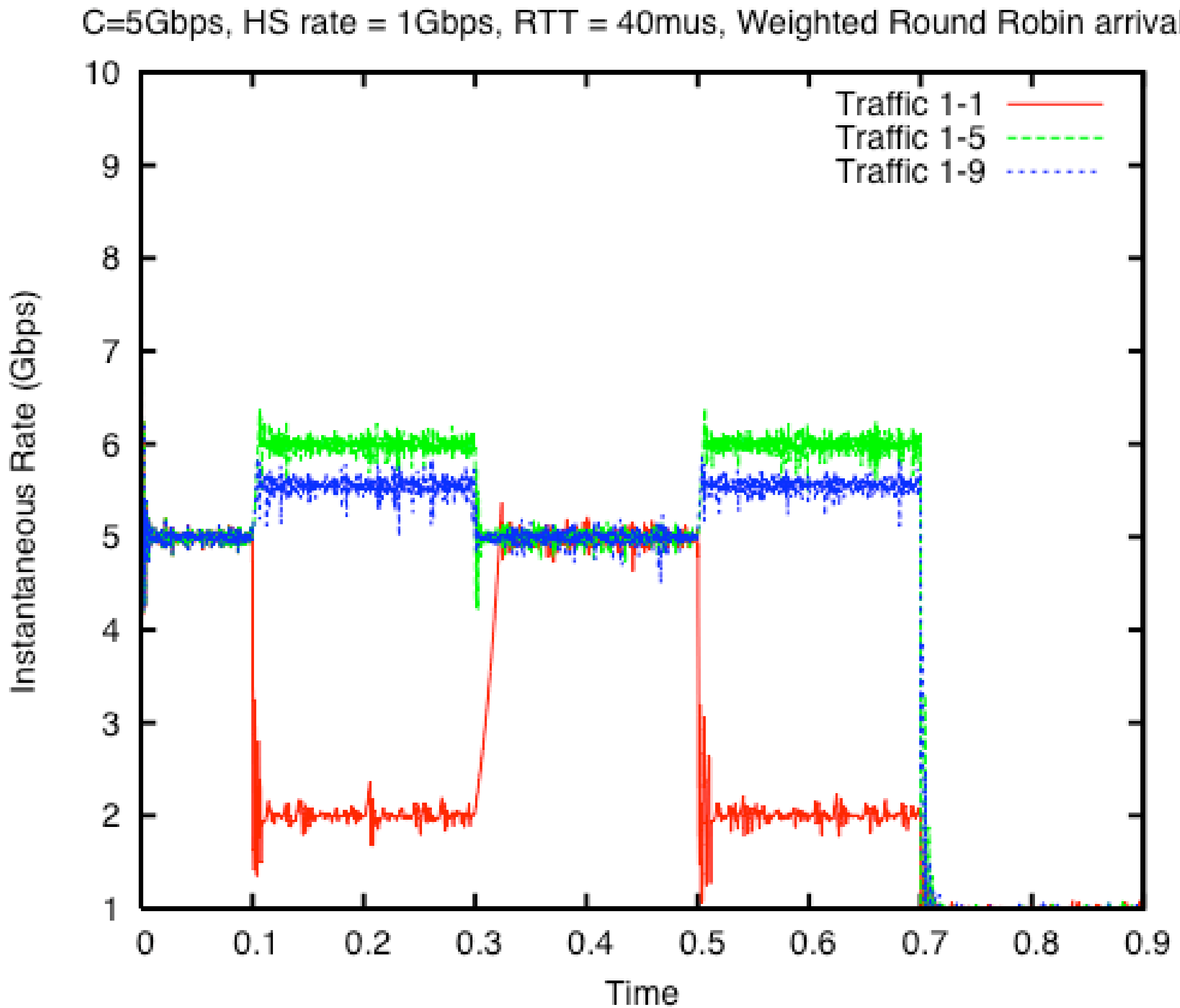




- Ideal rate of RL under QCN 2-point architecture shown above for traffic mix 1:5 and 1:9. The actual rate obtained is shown in the previous slide; it closely matches the ideal rate.

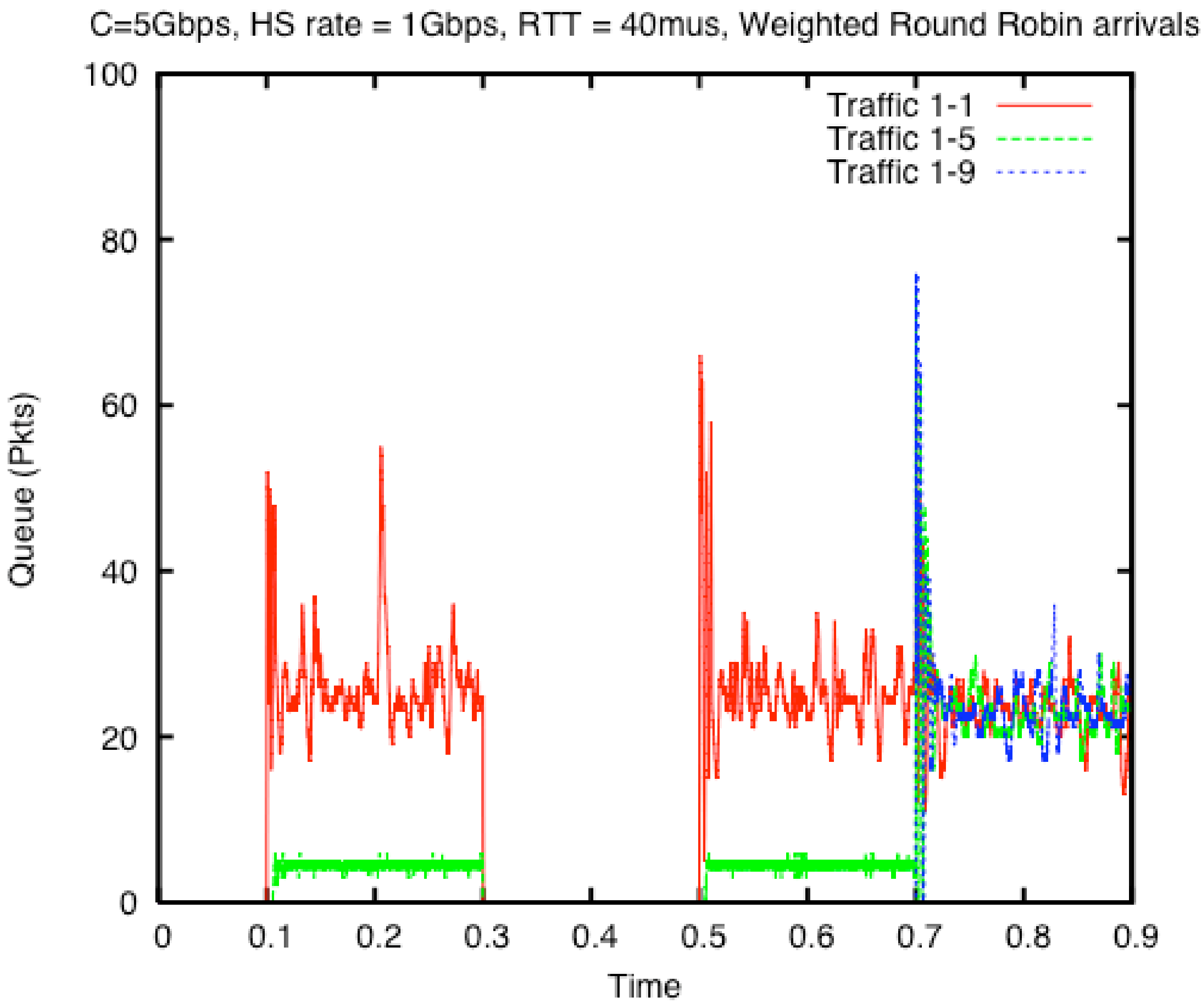
# Bernoulli; Bdwdth: 1G, 5G
# Queue size at 1G link



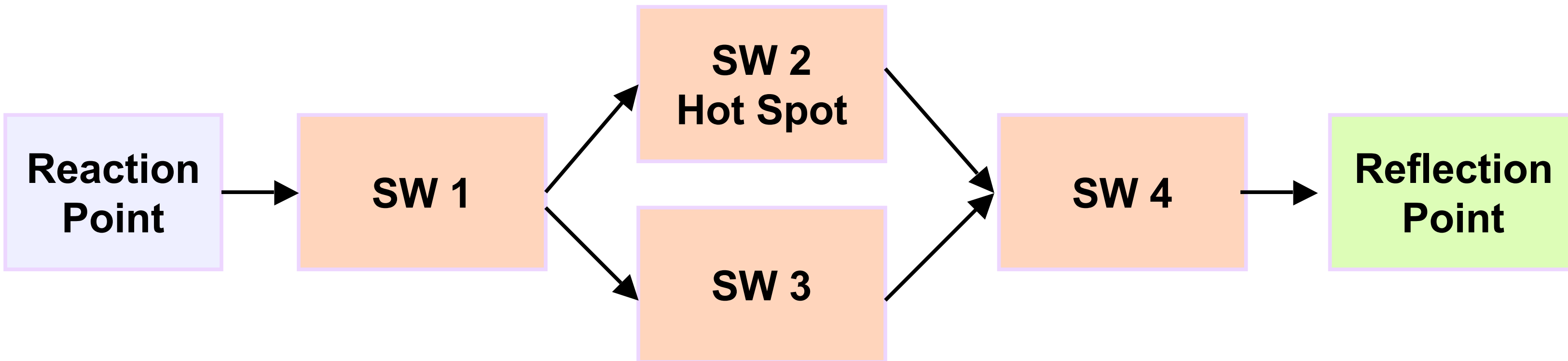
# Round robin; Bdwdth: 1G, 5G
# Rate of RL



# Round robin; Bdwdth: 1G, 5G
# Queue size at 1G link



# Discussion of 3-point architecture: Forward signaling




- **Problem:** Imagine SW 2 is congested, but SW 3 has bandwidth to spare. Probing or forward signaling will bring fluctuating positive and negative signals.
  - Cannot obey both signals because (a) Hot spot will be overloaded, (b) positive signals will be *more numerous.*
- Disambiguation of the signals requires path knowledge at either the ReaP or the RefP.
- If we used something like a CPID or other path info to get around this (even though we bring back the CP--RP association problem which we just got rid of)
  - There is a potential "stuck at low rate problem." That is, it is quite likely that the CPID at the ReaP will be that of SW 2. If the flow passing through SW 2 terminates, then the ReaP has stale CPID. Specifically, this causes the ReaP to ignore any positive signals from SW 3 and it has to rely on Active Increase to bring its rate up, rendering positive signaling ineffective.