Queueing

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FIFO Queueing
- Ensures that of all the packets that are sent out the one arriving early is sent out first.
- Tail-Drop - the packet arriving last is dropped.
  - FIFO does not imply tail drop - Drop policy is independent of queuing policy. For e.g., we can drop the packet which takes the largest space in the buffer.
- FIFO is not good enough - why?
  - Rogue sources can flood the router buffer; thus depriving other sources of their bandwidth.

Other Queueing Models
- Priority queues - can be used to distinguish classes of traffic
  - Higher class gets better treatment
  - Can starve low priority traffic
  - The rouge source problem still exists
- We need a round robin mechanism:
  - Naive round robin: Cycle over packets in a flow; if there are 2 flows send packets alternately from each flow. Great, works if packet sizes are the same.
  - But packet sizes differ; because of type of service, fragmentation in upstream routers etc.
  - So what do we do? We need to send bit by bit; however, routers do not forward bit wise, they can process only packets.
  - Thus we need to schedule packet processing order such that it simulates bit-by-bit round robin. Note that it cannot exactly be bit-by-bit, but we want it to be as close as possible.

Fair Queueing
- Calculating finishing times: \( F_i = \max(A_i, F_{i-1}) + P_i \)
- For high values of \( P_i \), the value of \( F_i \) tends to increase and thus will be scheduled later.
- Some properties of the algorithm:
  - Work conserving - If a packet is there to be sent it is sent, there is no reservation
  - Share automatically increases / decreases as number of flows decreases /increases
- Weighted fair queuing
- Interaction with Congestion Control