Achieving 100% Throughput in an Input-Queued Switch

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Problem Statement

- Discrete Time
- Consider M input switches, each with some Bernoulli arrival rate λ_i
- Each packet has a destination output (N)
- FIFO is not obeyed in an input queue!
- Given rates λ_{ij}, best way to route flow?

Virtual Output Queues

- We construct N VOQs (Virtual Output Queues) at each input queue
- We can, of course, know the length of each of the queues
- As long as we're guaranteed $\sum_i \lambda_{ij} < 1$ and $\sum_j \lambda_{ij} < 1$, we can achieve 100% throughput!
- We have to find a graph matching at each timestep

- Constructing the maximum size matching doesn't work and routing flow as per that doesn't work!
- Among maximum size matchings, even if we pick one at random each time, that also doesn't work!

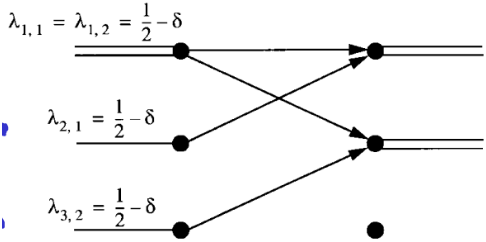

Figure 1: Alt text

Efficient Algorithms

Both achieve 100% throughput

LQF: Longest Queue First

- Weight the edges by L_{ij} (Length of jth VOQ at ith input)
- Find max weight matching in this
- (Can lead to starvation: not getting rid of initial conditions)

OCF: Oldest Cell First

- Weight the edges by W_{ij} (Waiting time of head of jth VOQ at ith input)
- Find max weight matching in this

MAB Version?

- Input as unknowns (not practical, as we can measure it anyways)
- Try to solve a weighted version, with regrets like (for instance) $R(t) = \sum_{ij} E[c_{ij} L_{ij}]$
- This can be interpreted as "power" in some sense:

Dynamic Power Allocation and Routing for Time Varying Wireless Networks

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(Again Lyapunov drift calculation is used)

Other ideas:

- MAB on Erasure channel with unknown erasure rates (idea of “min-cuts”)

Capacity of Wireless Erasure Networks

Amir F. Dana, *Student Member, IEEE*, Radhika Gowaikar, *Student Member, IEEE*, Ravi Palanki, Babak Hassibi, and Michelle Effros, *Senior Member, IEEE*

- Simple Deletion Channel