Max-Min Fairness

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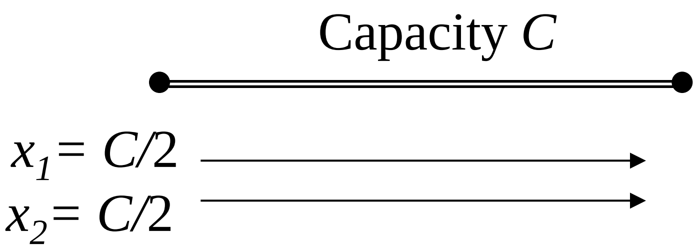
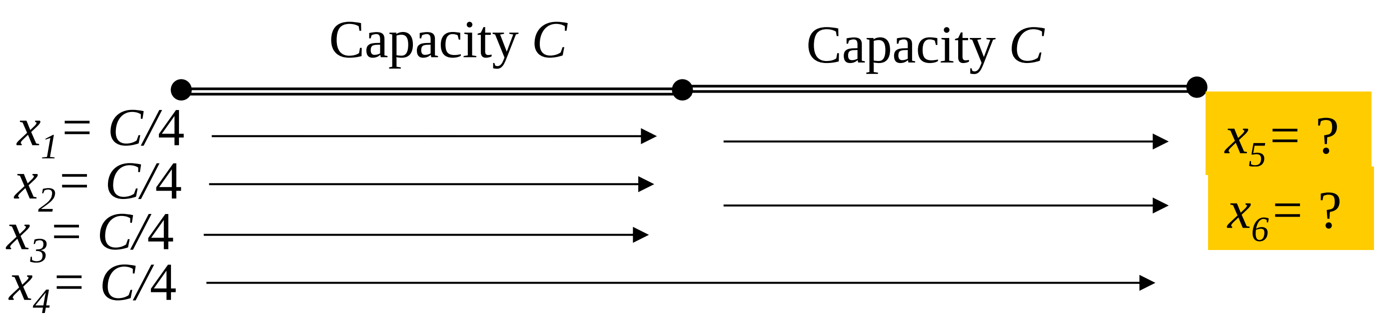
Fair Allocation of Bandwidth

- In a single link → Allocate equal quantities of bandwidth to all flows

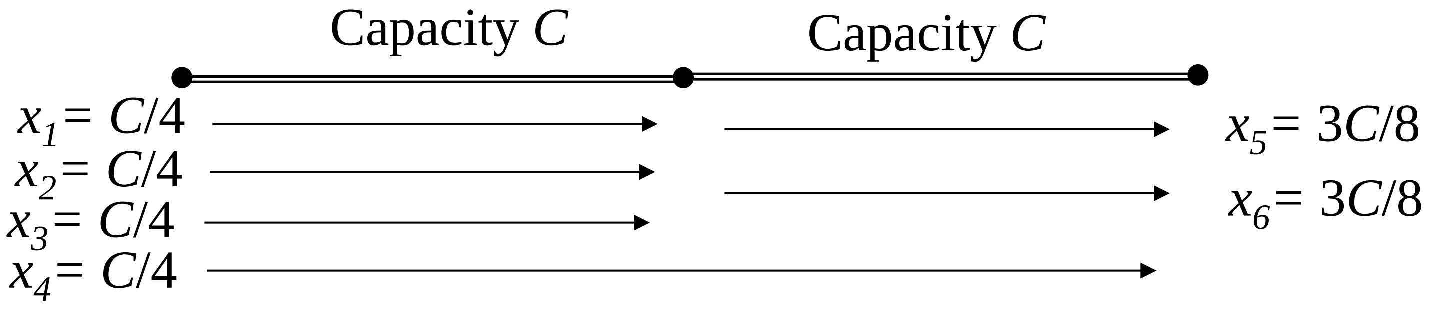


- This is not possible on a network-wide basis.
  - Constraint: a flow traversing multiple links should be allocated the same bandwidth in each link



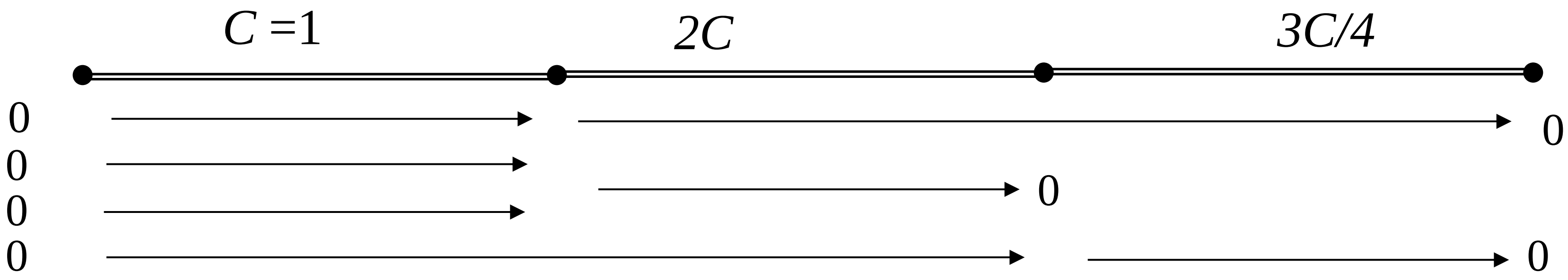
Max-min Fair Allocation

- Bandwidth allocation is “as balanced as possible”, while allocating as much bandwidth as possible.
- The bandwidth of a flow cannot be increased without decreasing that of a flow with less or equal bandwidth.

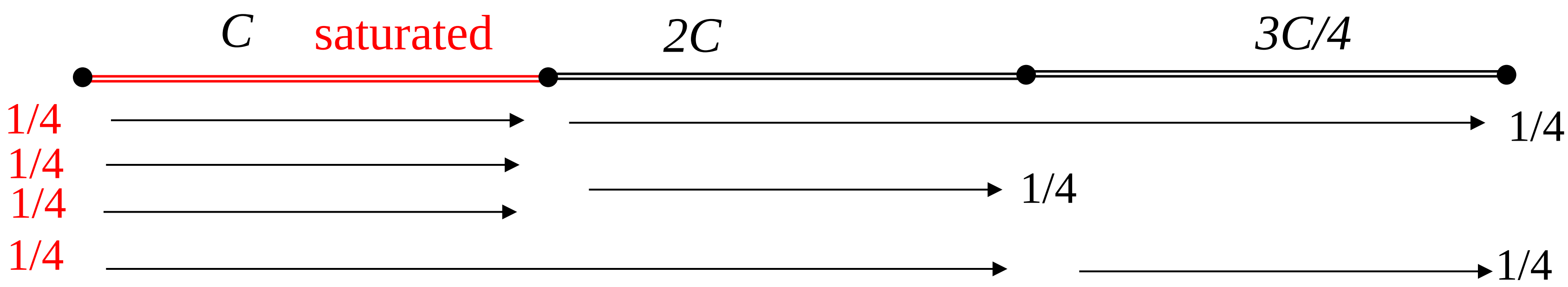


How is it derived ? → Filling process

- Initially all flows have 0 bandwidth.

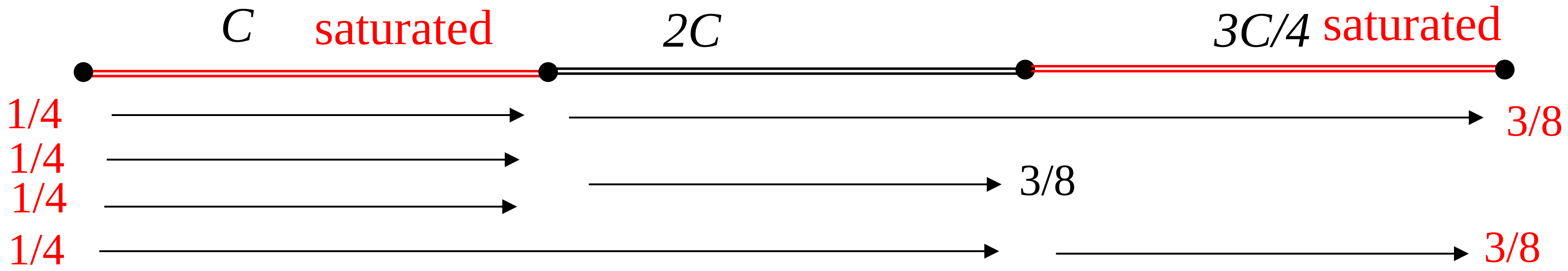


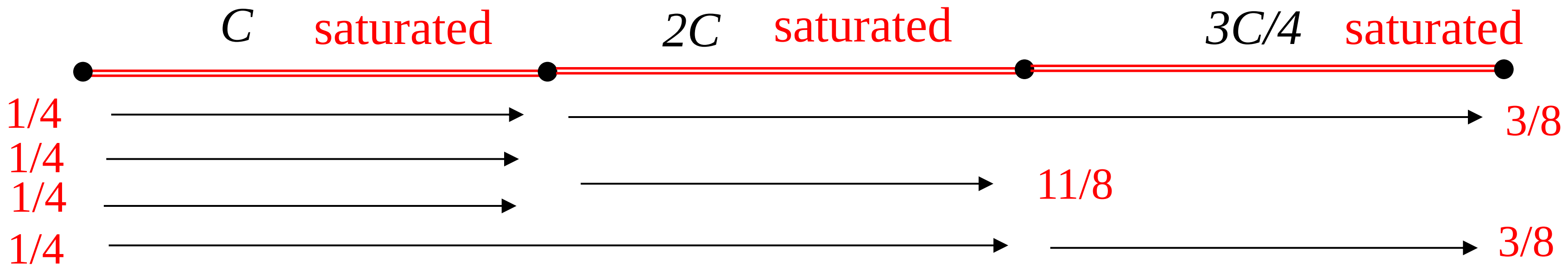
- Gradually increase all flows evenly, until some link gets saturated



How is it derived ? → Filling process

- Keep on increasing evenly all non-saturated flows, until there are no such flows anymore





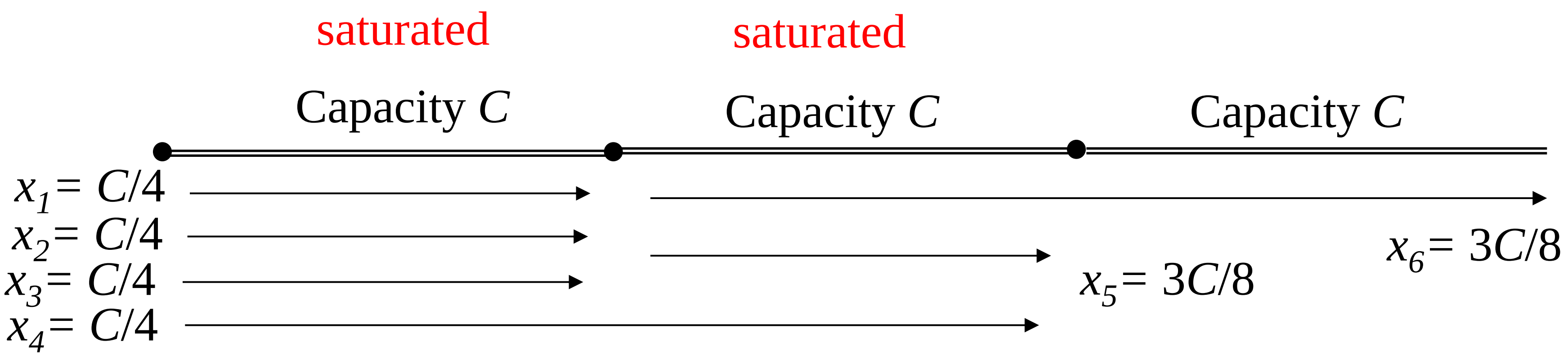
Why is this allocation max-min fair?

- Observations: According to the process
  - For the path of each flow *i*, there is a link *l* that is saturated <u>and</u> the bandwidth of the flow *i* is either greater or equal to that of <u>all</u> flows in this link *l*.
  - Indeed, this is the link where we stop raising the bandwidth of the flow.

- Thus, if the bandwidth of flow *i* were to be increased, then in the link *l* it can only obtain the extra bandwidth from flows with bandwidth already less than or equal to that of *i*

Last Observations

- Some bandwidth may inevitably be left unallocated at the end



- The sharing of bandwidth among ABR virtual circuits in an ATM network applying Explicit Rate congestion control approaches max-min the fair allocation