Communication Networks (0368-3030) / Spring 2011

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Max-Min Fairness – Another Example

Recommended references:

- Computer Networks - Performance and Quality of Service \ Ivan Marsic (available online)
- An Engineering Approach to Computer Networking \ S.Keshav

Generalization to a graph

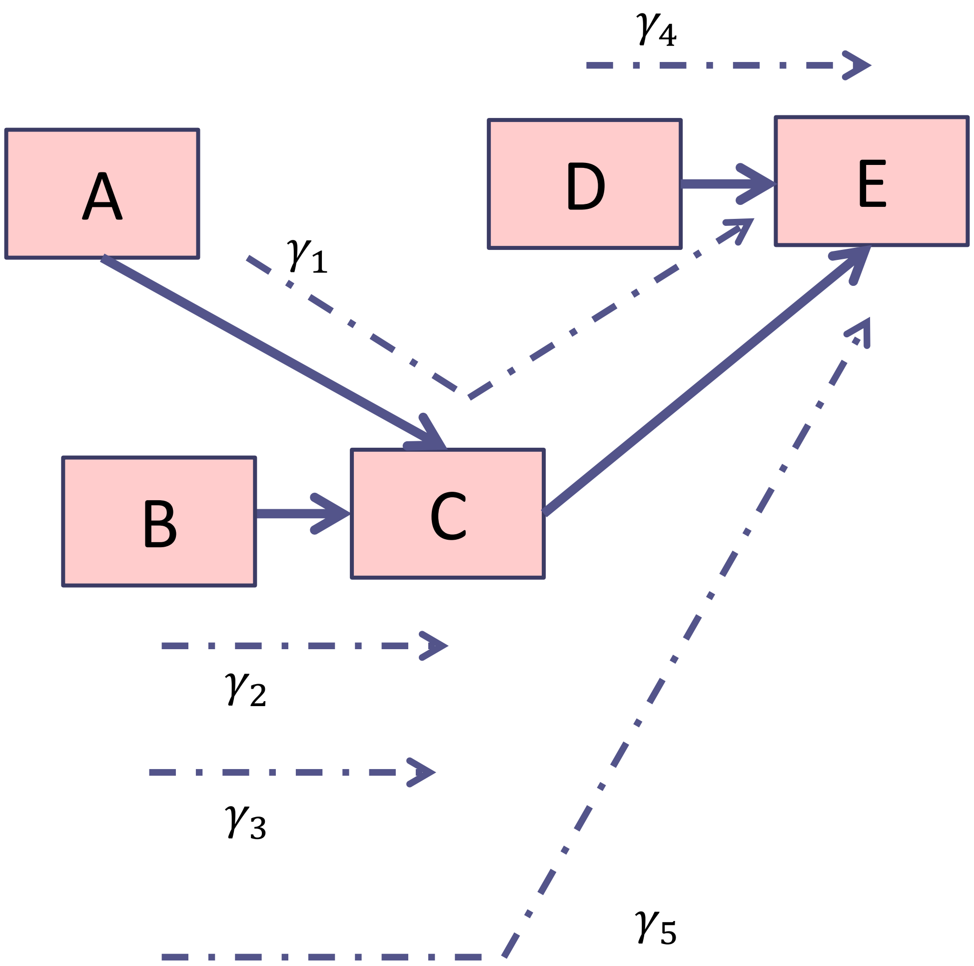
- We have a directed graph $G = (V, E)$, with capacity c_e for each edge e.
- We have a set of ongoing calls (flows). Each call i has demand r_i and a (fixed) path p_i.
- Algorithm:
  - Increase all flows equally until one link fills.
  - Fix the rate of the bottleneck flows.
  - Continue with the unfixed flows.

Algorithm – in more detail

1. Assign flow 0 for all calls.
2. Let S be the set of all calls.
3. Increase the rate equally for all demands in S until:
   a) some link is saturated
      – OR –
   b) until some demand is fulfilled
4. Remove all the calls passing through the saturated links, and all the calls whose demand is fulfilled from S.
   - (these calls' rates become fixed – these rates will not change anymore)
5. Return to step 3, until there are no more calls left in S.

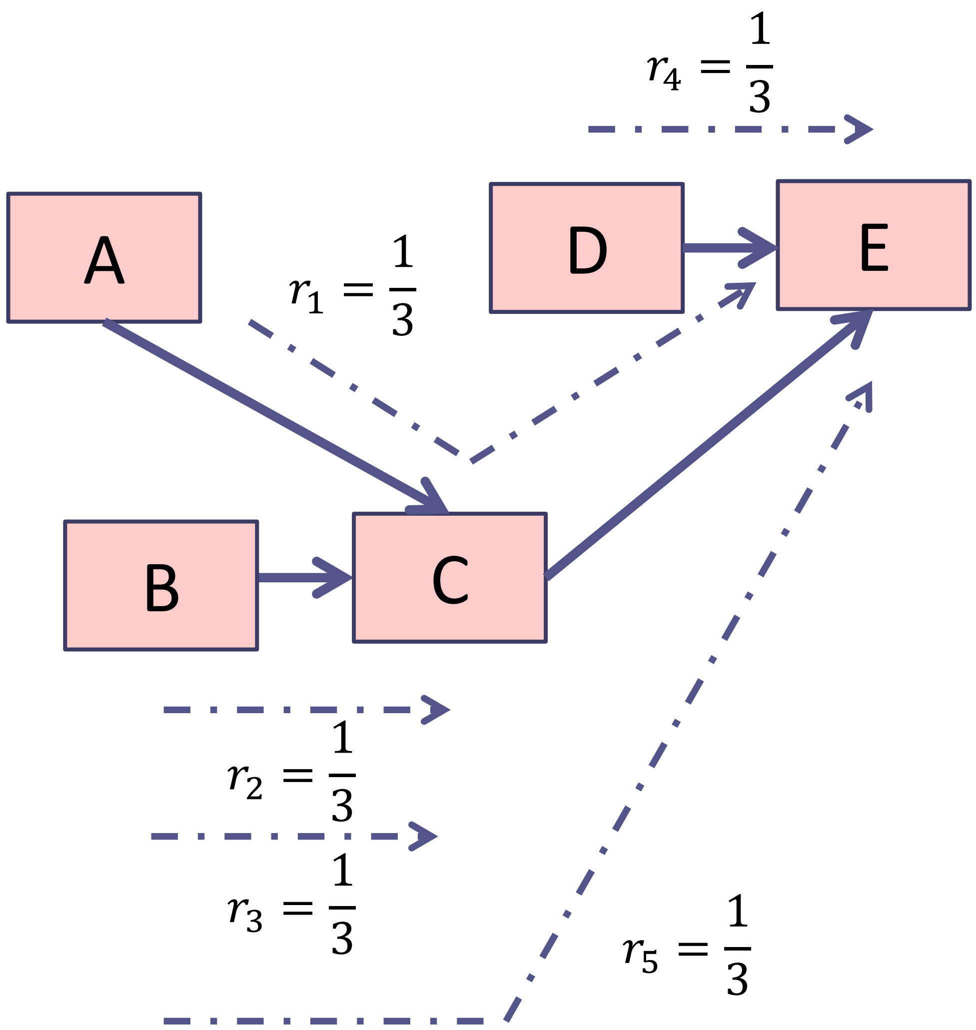
An example

- A network with 5 nodes, and 5 calls $\gamma_1, \dots, \gamma_5$.
- All link capacities are 1.
- All demands are ∞.
- $S = \{\gamma_1, \dots, \gamma_5\}$, $\forall i = 1, \dots, 5. r_i = 0$



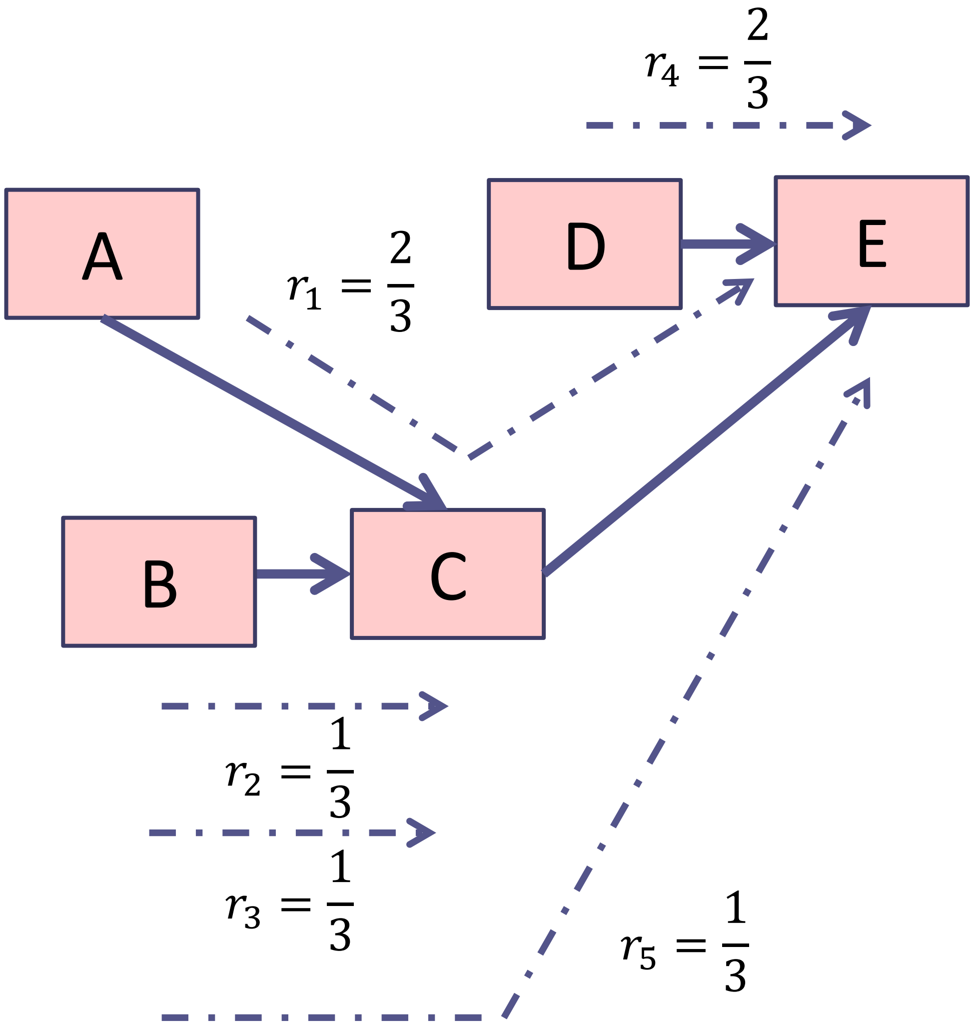
An example

- Increase all flows in S equally.
- When all flows get rate 1/3 link (B, C) becomes saturated.
- $\gamma_2, \gamma_3, \gamma_5$ are removed from S, hence their rates will no longer change.
- $S = \{\gamma_1, \gamma_4\}$



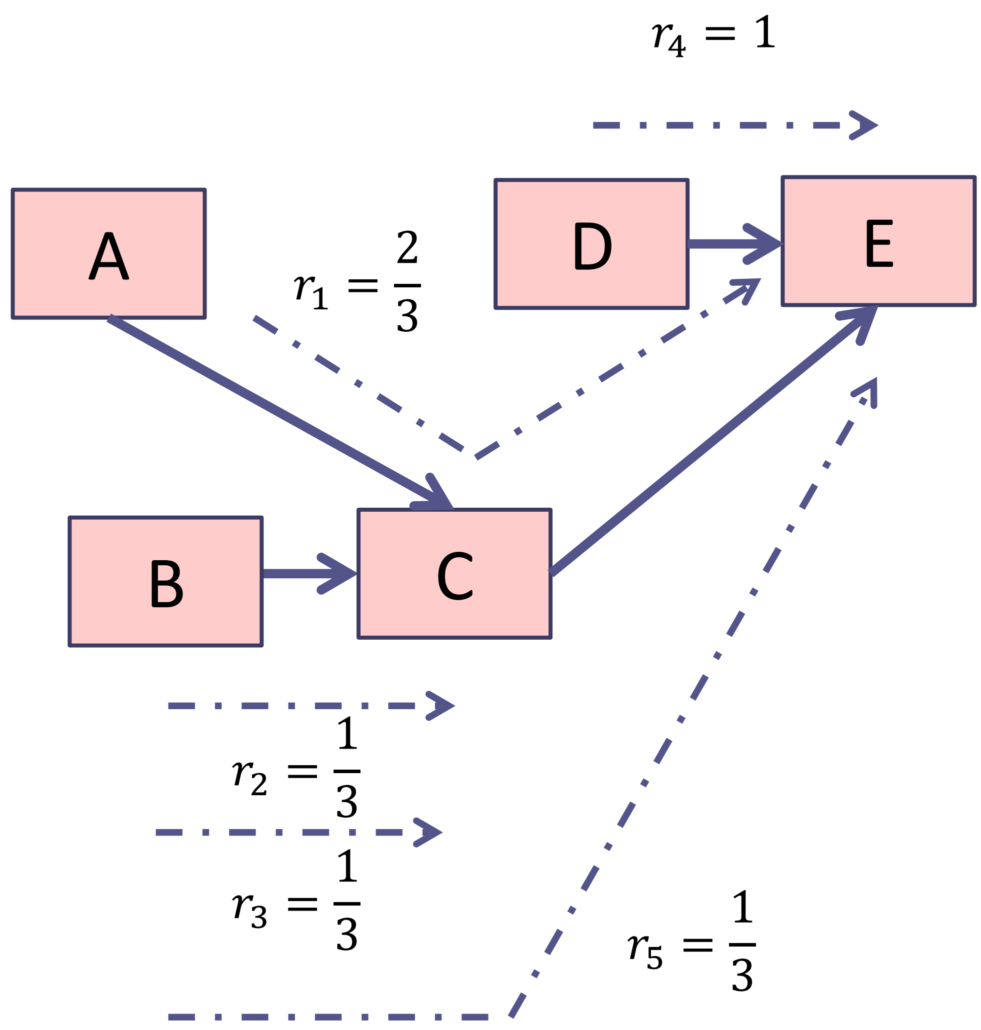
An example

- Increase all flows in S equally.
- When you reach 2/3 link (C, E) becomes saturated.
- $S = \{\gamma_4\}$



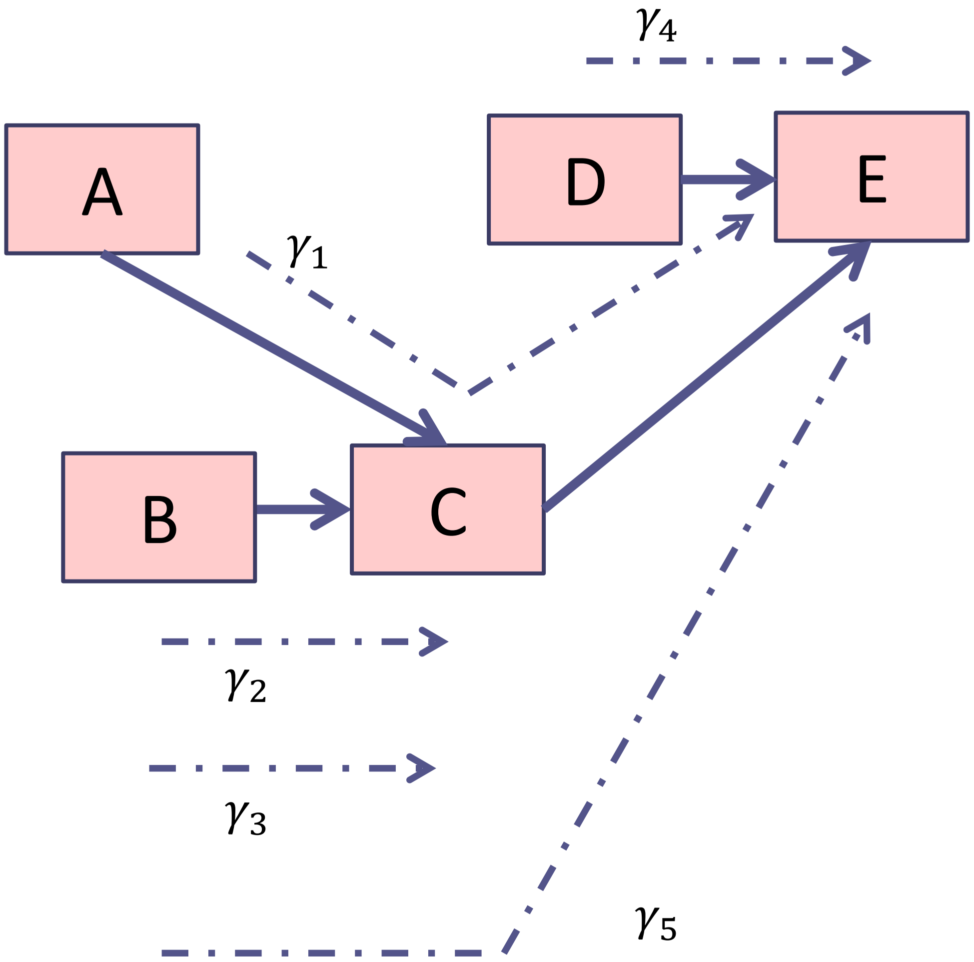
An example

- Increase all flows in S equally.
- When you reach 1 link (D, E) becomes saturated
- $S = \Phi$



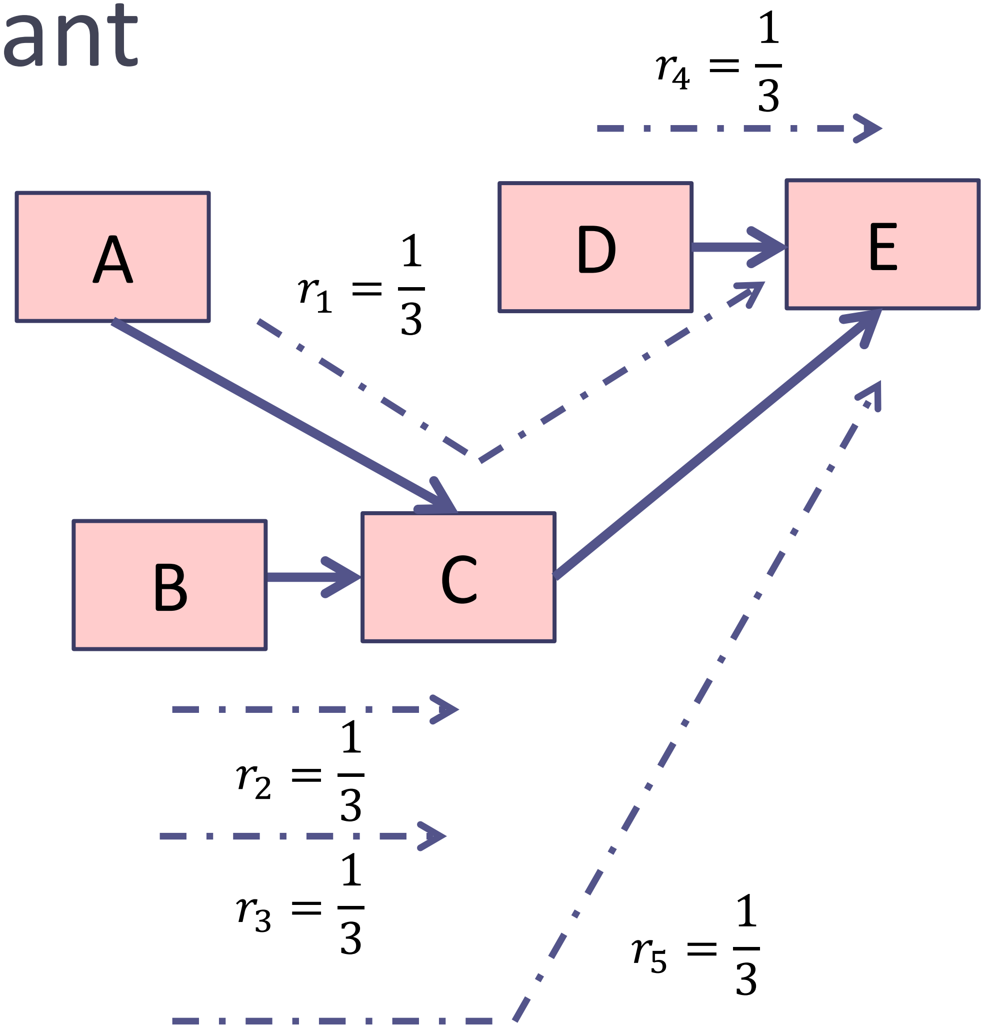
An example - variant

- A network with 5 nodes, and 5 calls $\gamma_1, \dots, \gamma_5$.
- All link capacities are 1.
- All demands are 0.5.
- $S = \{\gamma_1, \dots, \gamma_5\}$, $\forall i = 1, \dots, 5. r_i = 0$



An example - variant

- Increase all flows in S equally.
- When all flows get rate 1/3 link (B, C) becomes saturated.
- $\gamma_2, \gamma_3, \gamma_5$ are removed from S, hence their rates will no longer change.
- $S = \{\gamma_1, \gamma_4\}$



An example - variant

- Increase all flows in S equally.
- When you reach 1/2 the demands γ_1, γ_4 are fulfilled.
- γ_1, γ_4 are removed from S.
- $S = \Phi$