A multi path routing algorithm for IP networks based on flow optimisation

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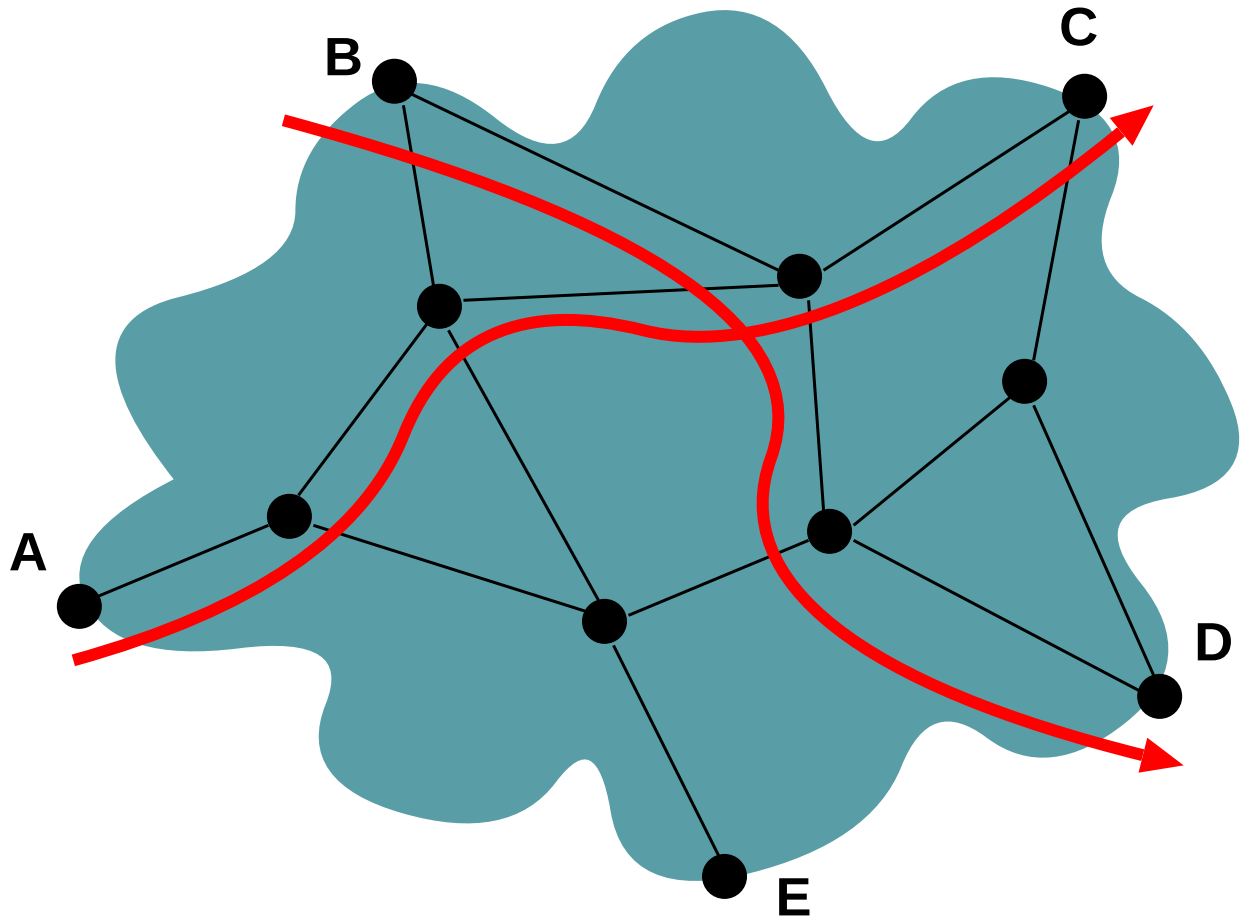
Outline

- Background and goals
- Optimisation algorithm
- Forwarding
- Conclusions

SPF routing



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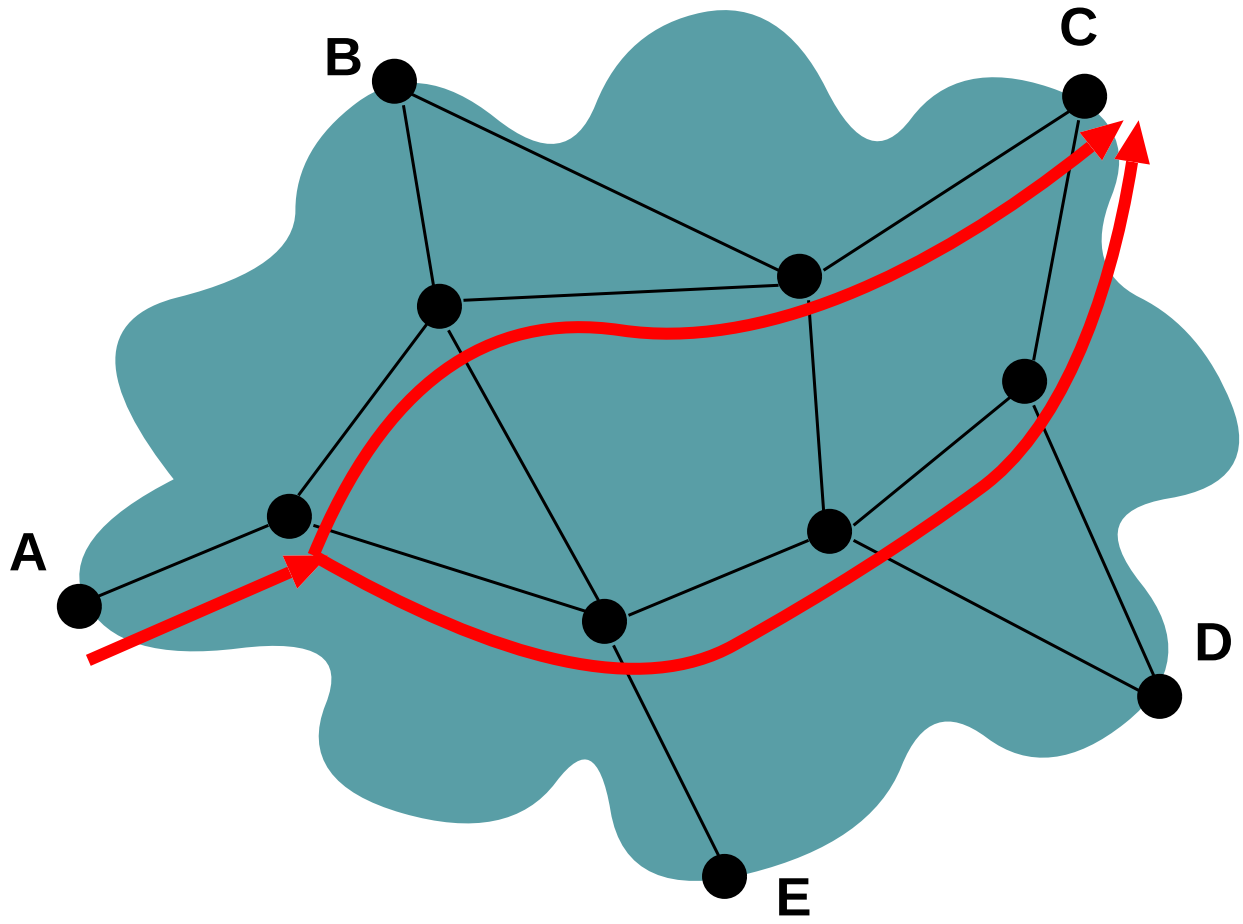
Packet flow optimisation



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The project and its motivation

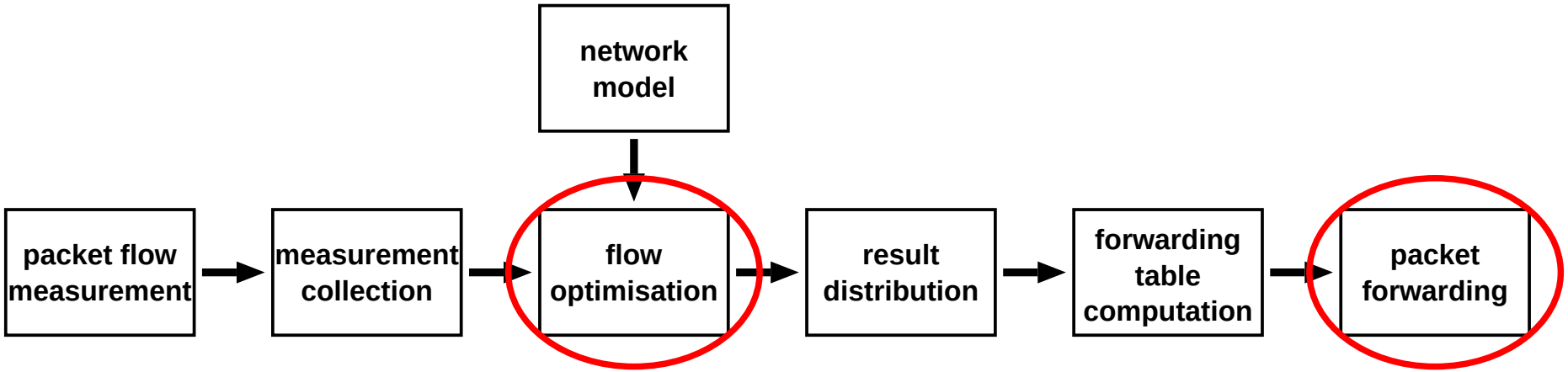
- Todays routing: some form of shortest path
- **We want to**:
  - load balance over several paths
  - avoid congestion when possible
  - make better use of network capacity
- *Longer term goal*: design optimising routing protocol that can replace OSPF/IS-IS.

  (Extreme and perhaps not realistic. . .)

Main results

- An optimisation algorithm based on multi-commodity flow optimisation
- A forwarding mechanism which is suited for the algorithm
- A flow analysis study
- A simulation platform based on MaRS, CPLEX and daVinci

Optimising routing architecture



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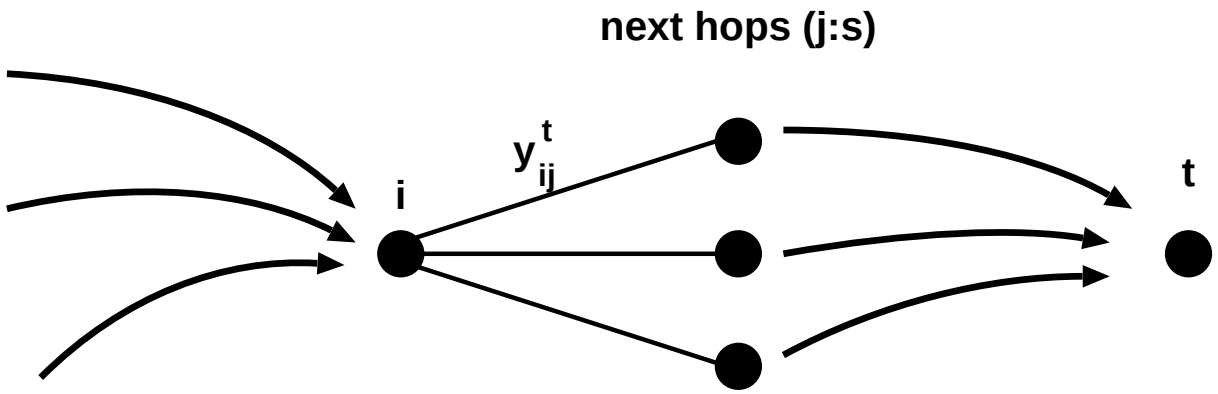
Contributions

- Optimisation problem modelling: all traffic destined for a certain egress are aggregated into one commodity
  - reduces complexity by reducing the number of commodities to N compared to N^2 if ingress-egress pairs are used
  - makes forwarding simple without need for MPLS
- An objective function which allows the operator to tune the tradeoff between utilisation and balance

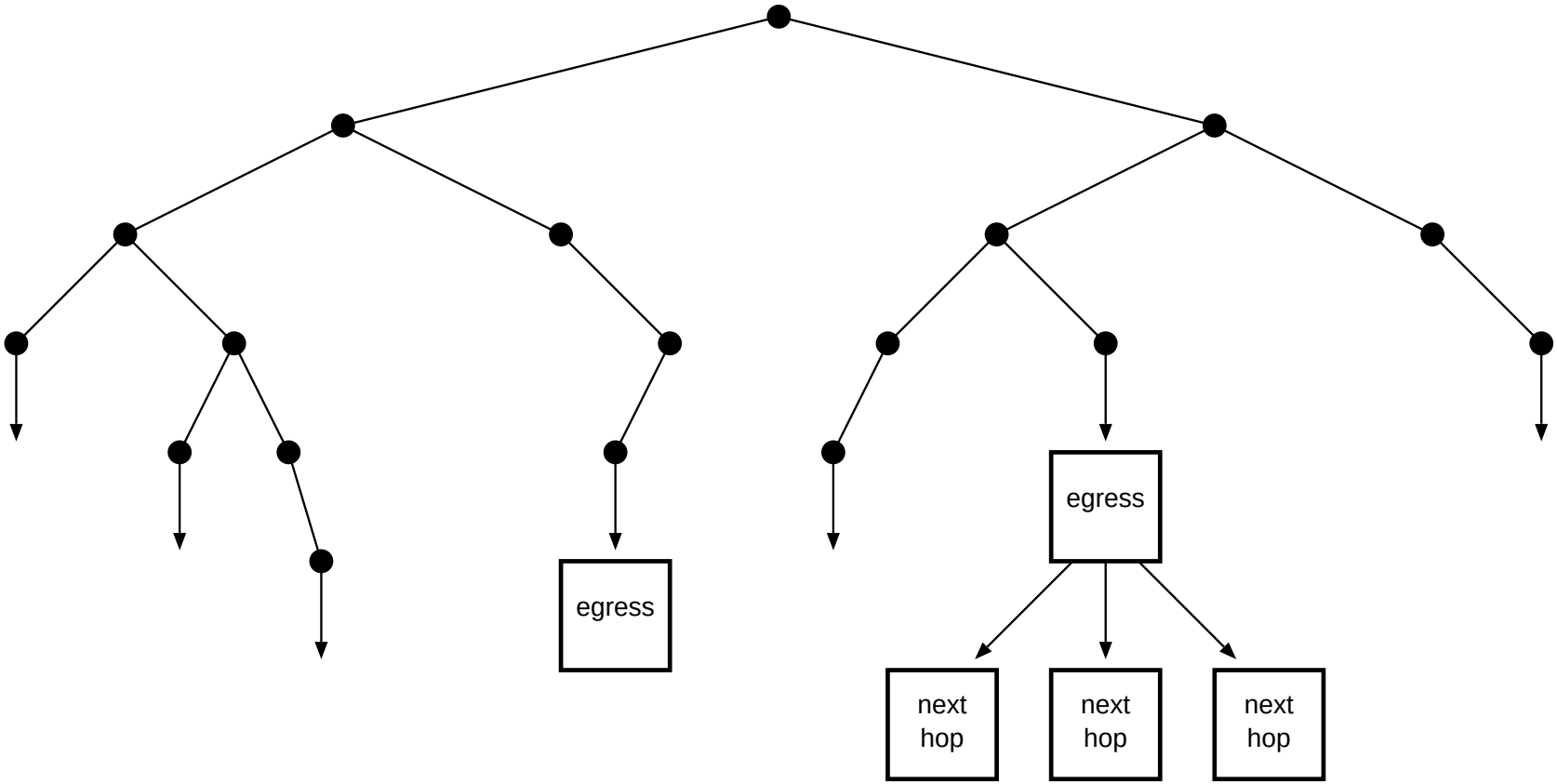
(hand written slides. . .)

Packet forwarding – new requirements



- Result from optimisation, y^t_{ij} values, tell how node i should distribute traffic destined for egress t between the next hops j.
- Must be able to identify egress node
- Must be able to split traffic between several next hops

Modified packet forwarding



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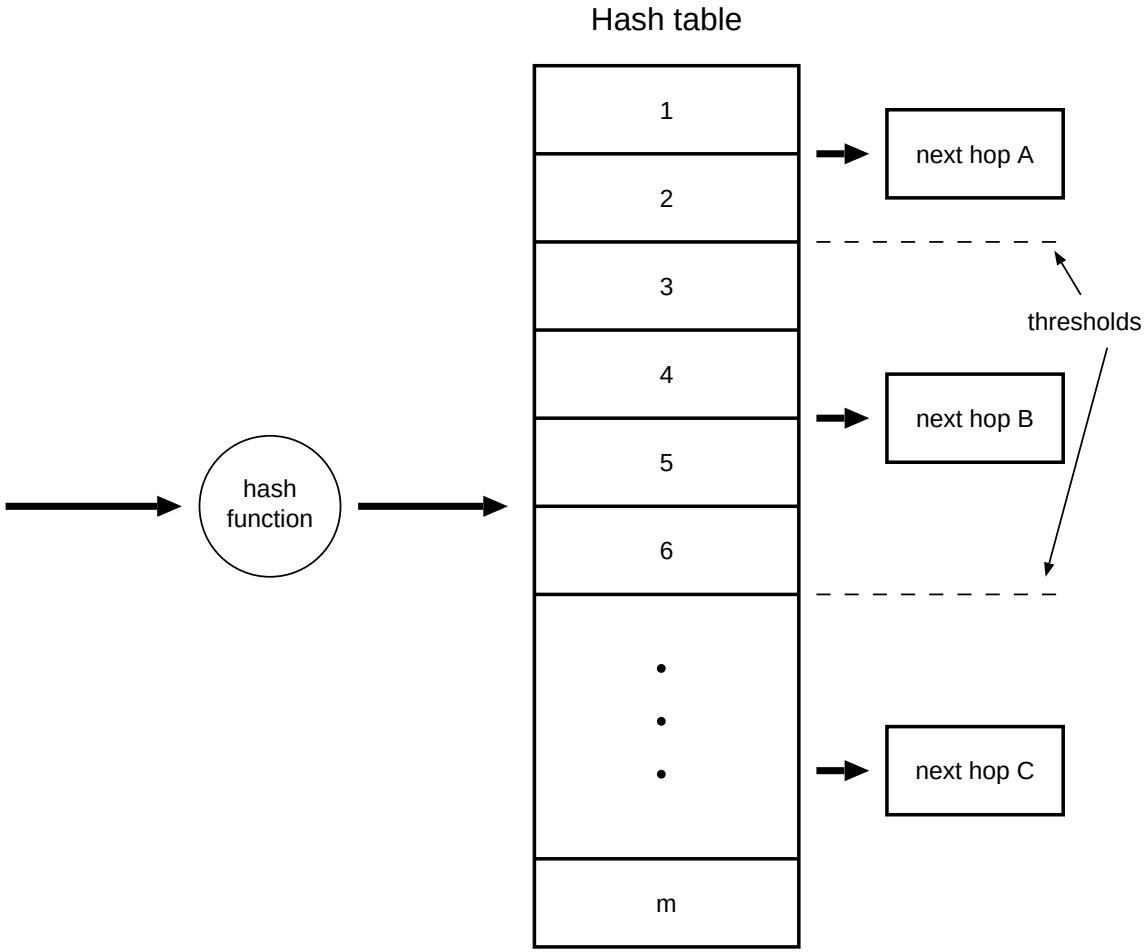
Packet forwarding – hash based splitter

- Want to keep individual TCP connections on a single path
- Hash function on the five-tuple (source address, destination address, source port, destination port, protocol id), or a subset thereof
- Dynamic adjustment to reach the desired split ratio
- Evaluation by Cao *et al.*

Packet forwarding – hash based splitter



Conclusions

- Taken the first steps to introduce flow optimisation as a routing algorithm
- Designed an optimising routing algorithm which we claim is computationally tractable for on-line calculation
- Requires only a small modification to the legacy packet forwarding mechanism
- A cost function which provides a simple way of tuning the trade-off between balance and utilisation

Future work: design a routing protocol using the algorithm

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