



Taking the Shortcut – Advances in Segment Routing Traffic Engineering

Alexander Brundiers

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Rotterdam, May 22–26, 2023

Traffic Engineering in one (simplified) sentence:

Control the paths of traffic flows in your network to achieve various objectives.

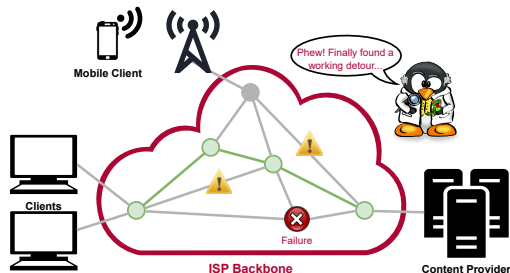


Image sources/credits in the appendix

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Possible Use Cases or Objectives:

- ▶ Avoid faulty network elements
- ▶ Reduce energy consumption (GreenTE)
- ▶ Reduce load of highly utilized links
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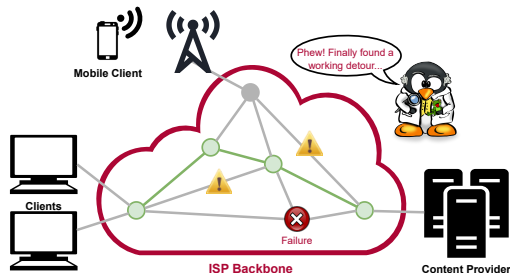


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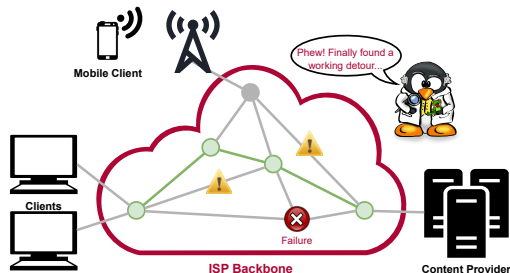


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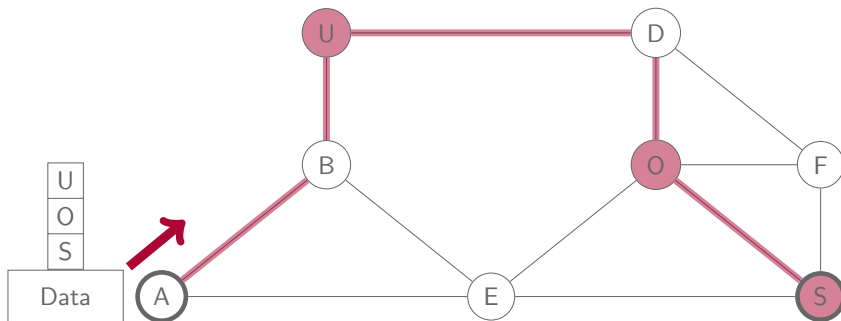
Implemented via *Metric-Tuning*, *MPLS (with RSVP-TE)*, *Segment Routing*, ...

Segment Routing (SR) Main Idea:

- ▶ Control a packet's path by defining **interim destinations/waypoints**

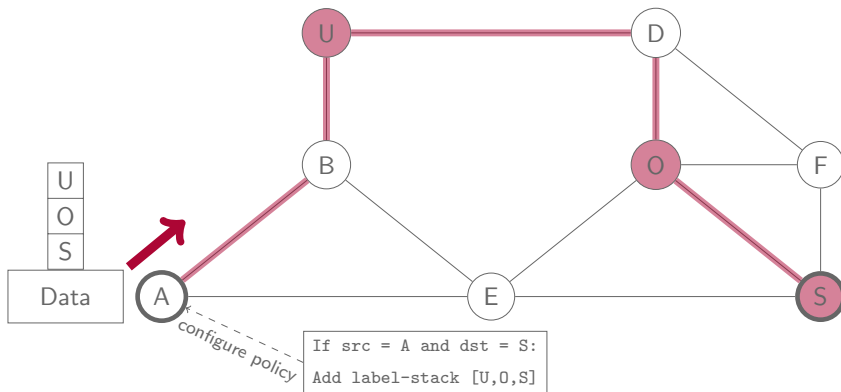
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Terminology:

SR Policy: "Rule" determining which segments to add to a packet

Operators generally prefer **lower policy numbers**:

- Simplify network management
- Improved clarity, maintainability and robustness, ...

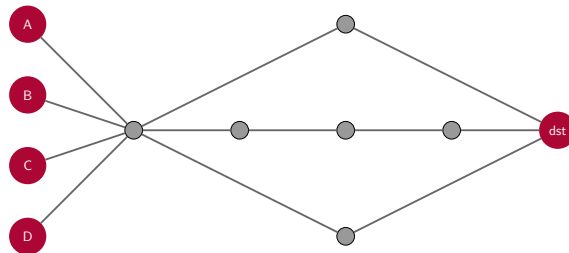
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SR-TE literature focuses **solely** on an **end-to-end** use of SR policies!

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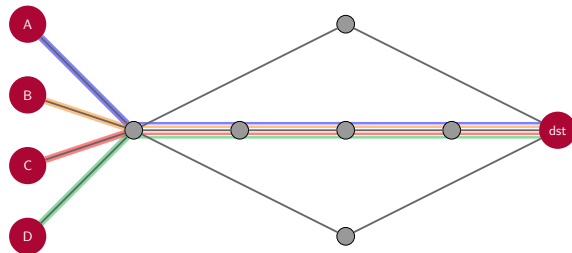
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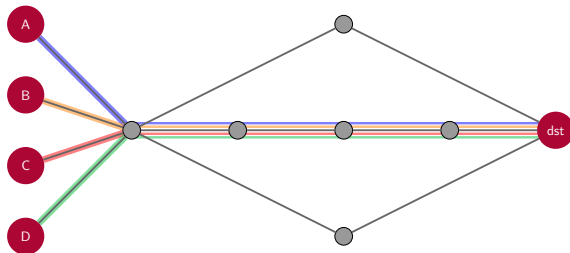
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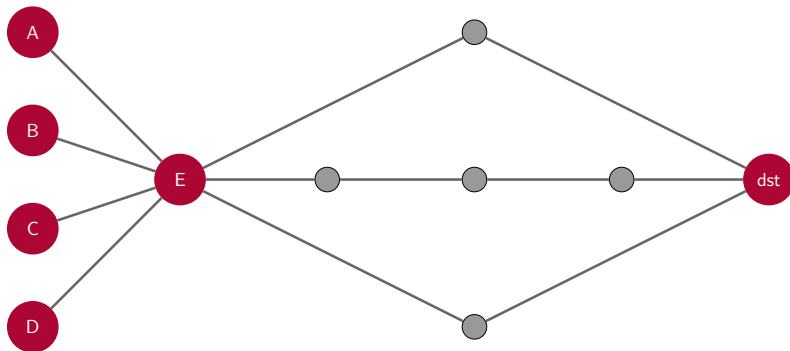


→ Potentially (unnecessarily) high policy numbers

Make policies usable by more than one demand. (no longer end-to-end)

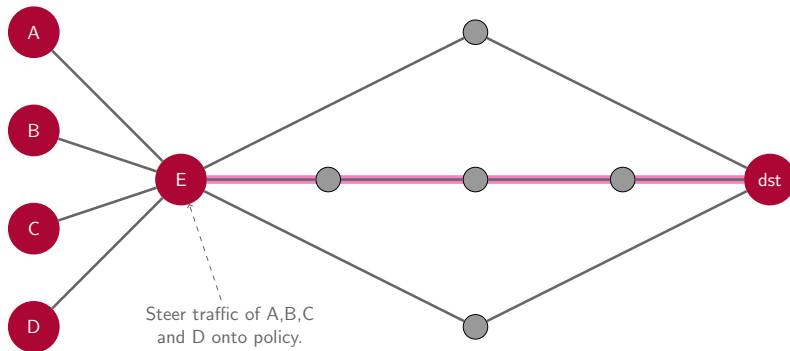
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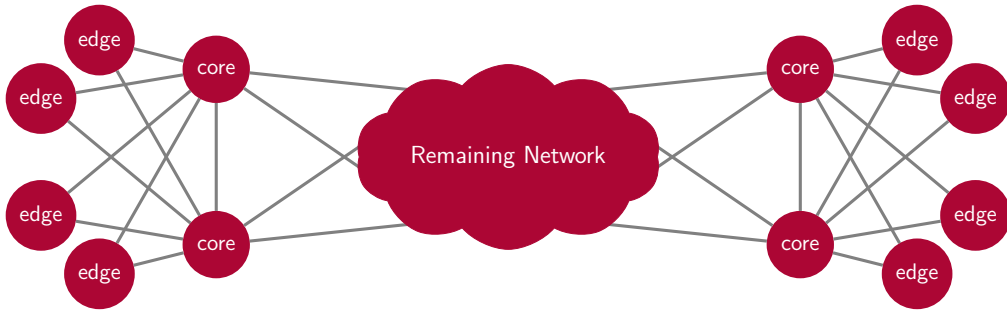


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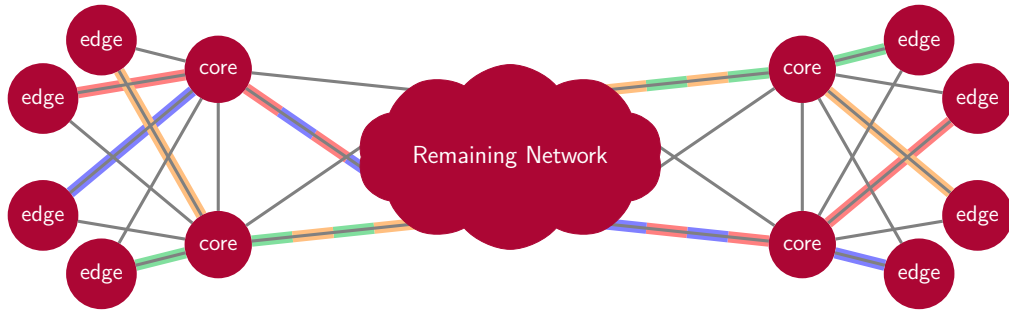
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Common ISP Backbone structure:

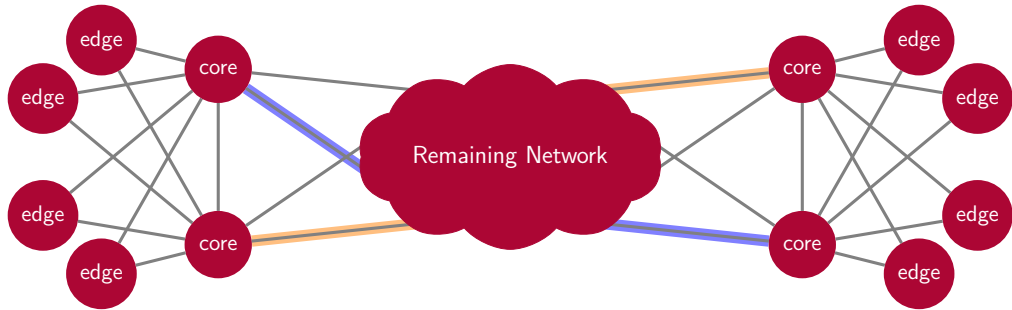


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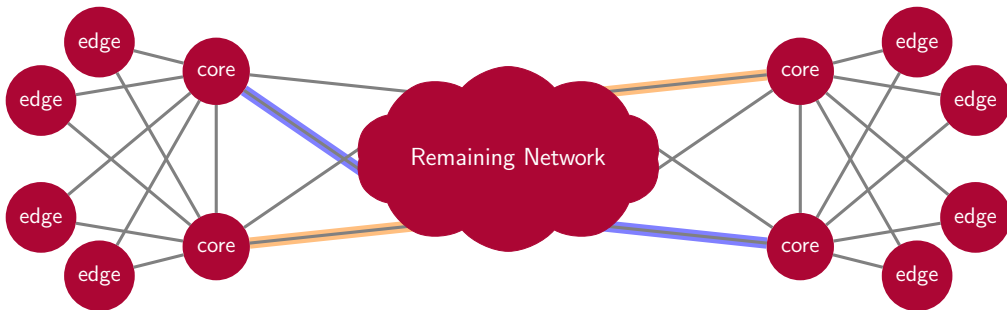
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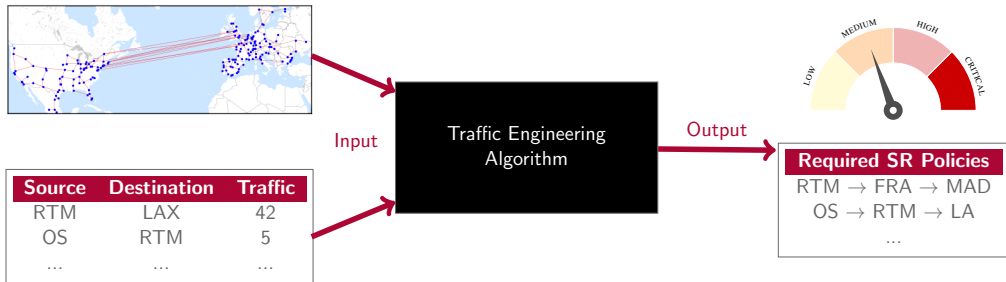


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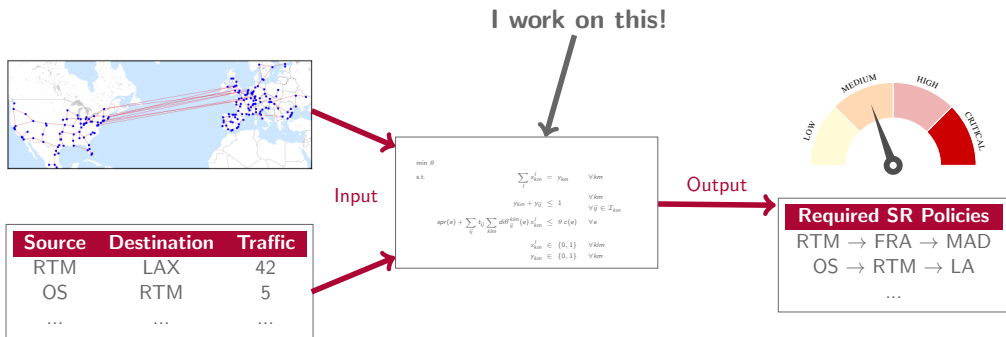
- ▶ Technical foundations exist! (*Midpoint Optimization, IGP Shortcut, Autoroute*)
They are just **not used** (in literature).

We already **have the technical foundations**, but we **need algorithms** that tell us how to use them in the best possible way.

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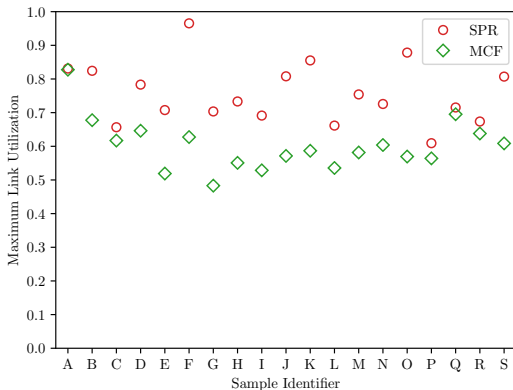
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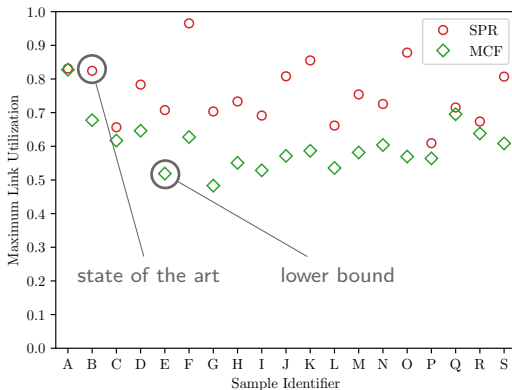
Central research aspects:

- ▶ **Solution Quality**
→ Similar to end-to-end SR?
- ▶ **Policy Numbers**
→ Reduction of SR policies in practice?
- ▶ **Algorithmic Complexity**
→ Computation time & resource demands

Tier-1 ISP Backbone Network:

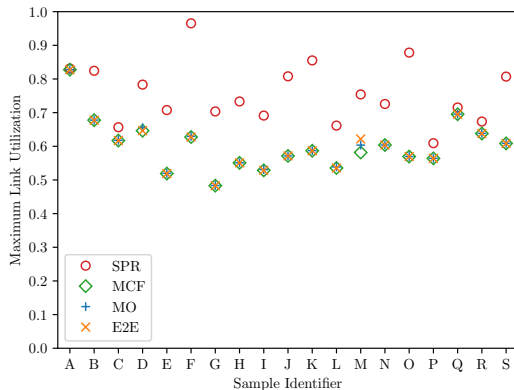


Tier-1 ISP Backbone Network:



Brundiers et al., "Midpoint Optimization for Segment Routing", IEEE INFOCOM, 2022

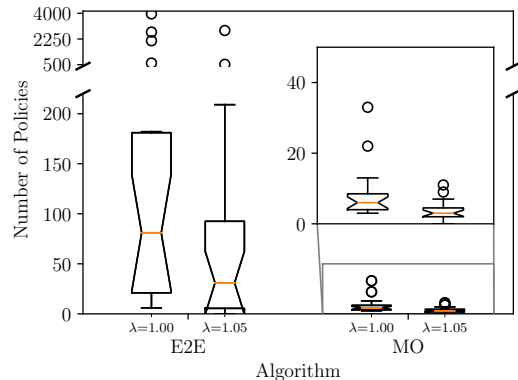
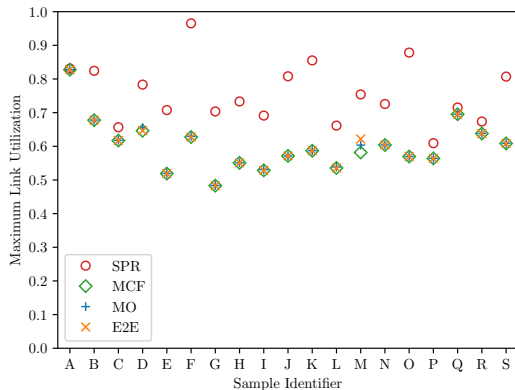
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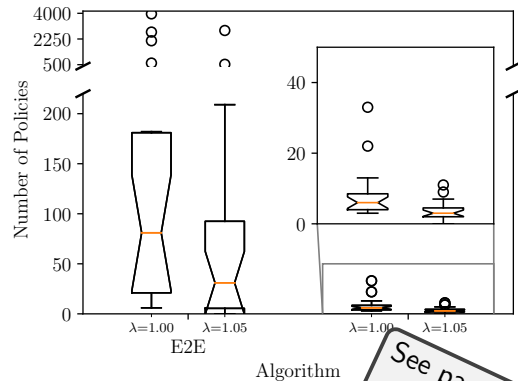
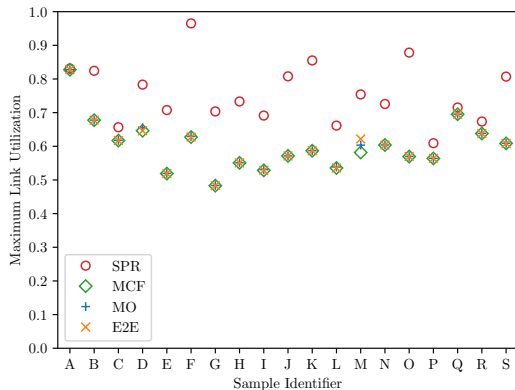


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See paper for more results!

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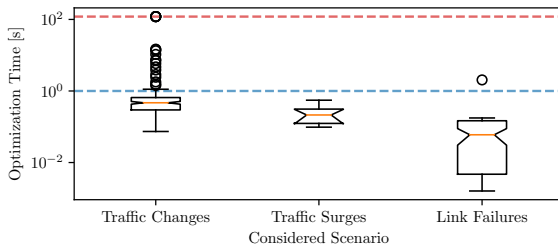
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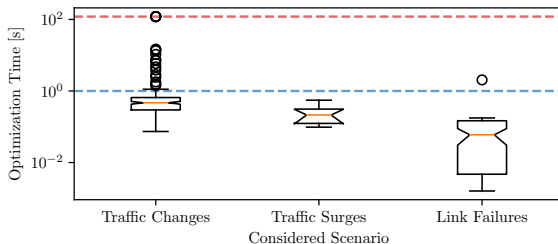


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Time's up? Find me at
<https://sys.cs.uos.de/brundiers/>
or contact me directly:
brundiers@uos.de

Future Work: Hybrid approaches combining MO and E2E SR.

If you are interested in the details of our work:

- ▶ Brundiers et al., "*Midpoint Optimization for Segment Routing*", IEEE INFOCOM, 2022.
- ▶ Brundiers et al., "*Tactical Traffic Engineering with Segment Routing Midpoint Optimization*", (accepted for IFIP Networking 2023)



This work was supported by the *Deutsche Telekom AG*. The information and views expressed in this talk do not necessarily reflect the views of the *Deutsche Telekom AG*.

Appendix

The “scientist tux” (penguin) on **Slide 2** is taken from:

M. Barbieri, 2010, “*Tux version of scientist Lazzaro Spallanzani*”, Wikimedia Commons.

online: https://commons.wikimedia.org/wiki/File:Tux_Spallanzani.svg

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