



# Taking the Shortcut – Advances in Segment Routing Traffic Engineering

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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.

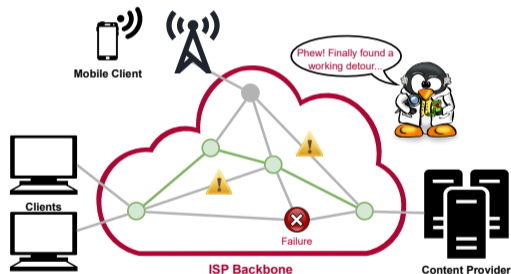


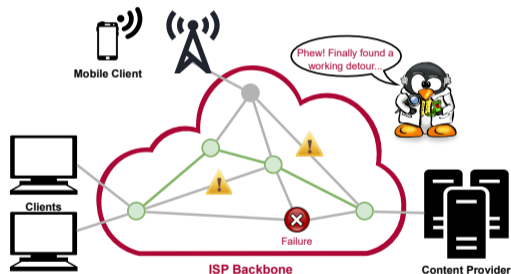
Image sources/credits in the appendix

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- ▶ Avoid faulty network elements
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- ▶ Reduce load of highly utilized links
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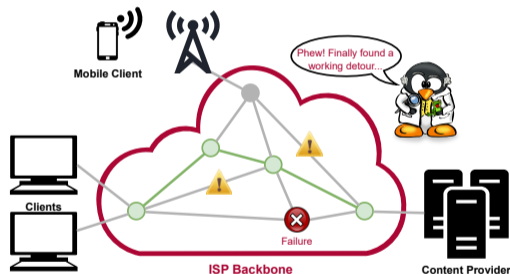


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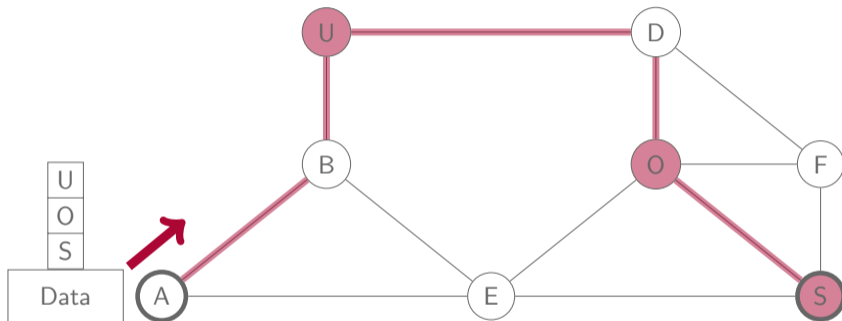
Implemented via *Metric-Tuning*, *MPLS (with RSVP-TE)*, *Segment Routing*, ...

## Segment Routing (SR) Main Idea:

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

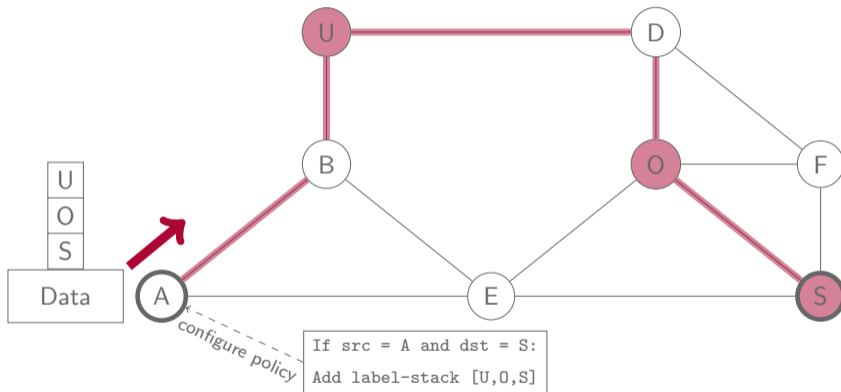
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Terminology:

**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, ...



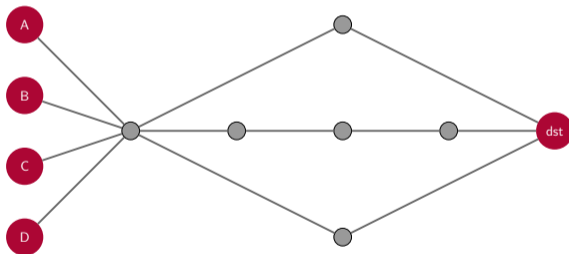
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**Problem:**

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

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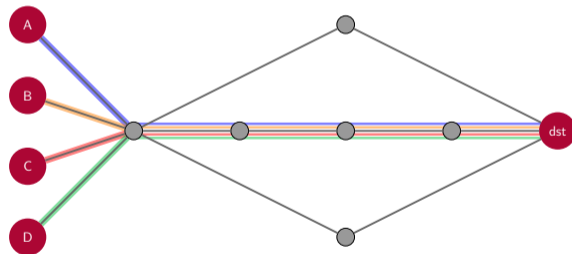
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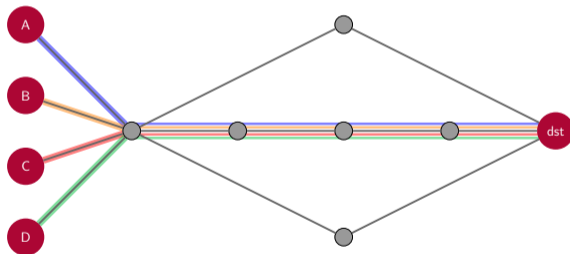
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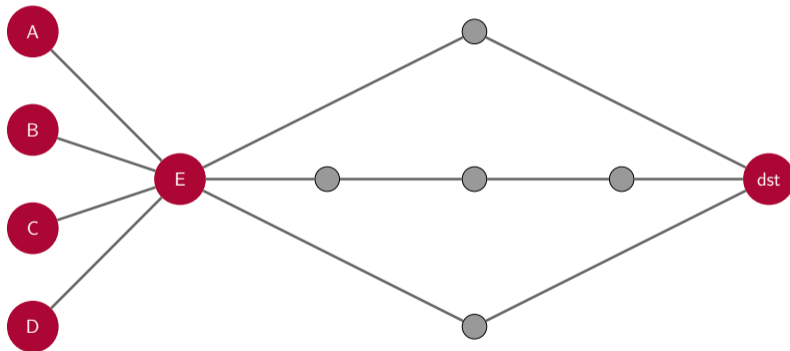


→ Potentially (unnecessarily) high policy numbers

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

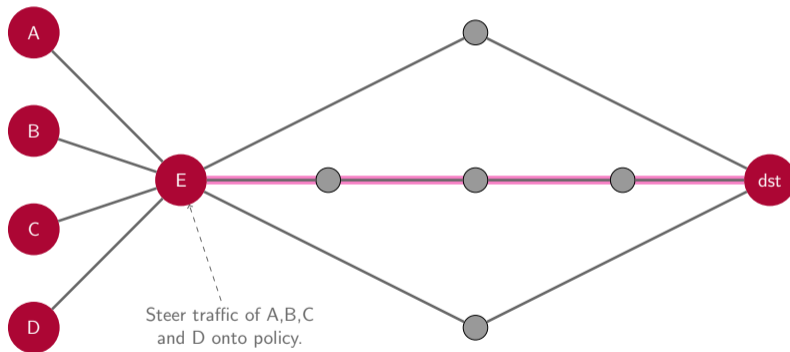
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Example from before:

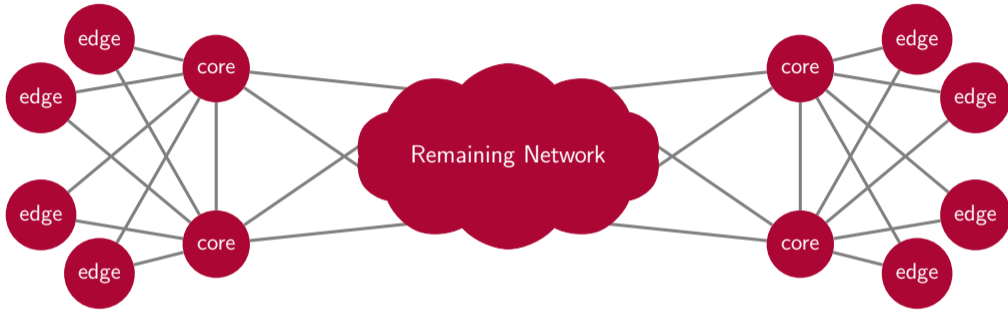


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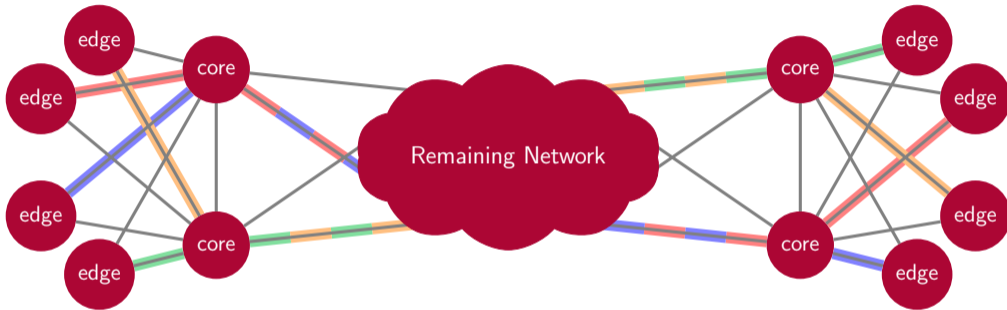
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## Common ISP Backbone structure:



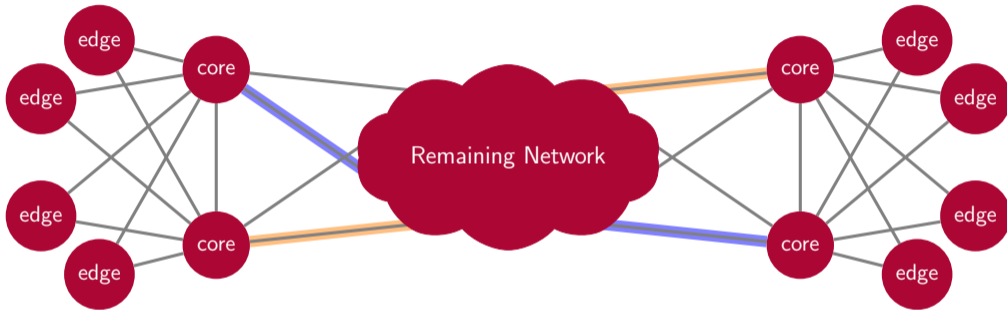
Common ISP Backbone structure:



Instead of **many end-to-end policies** ...

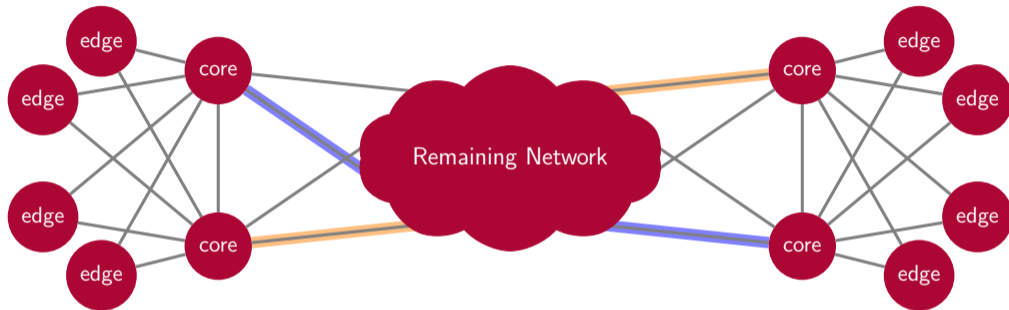


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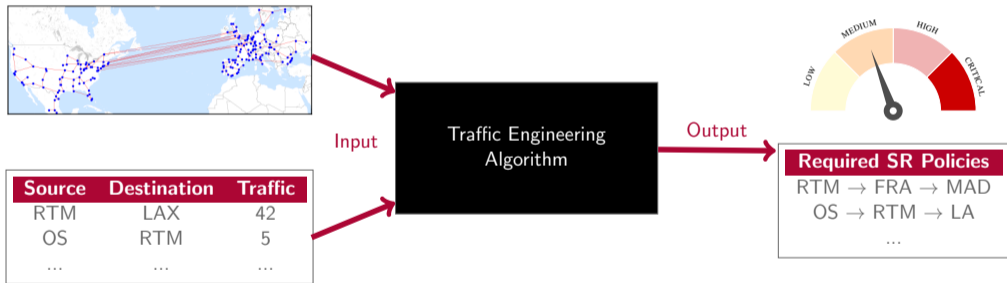


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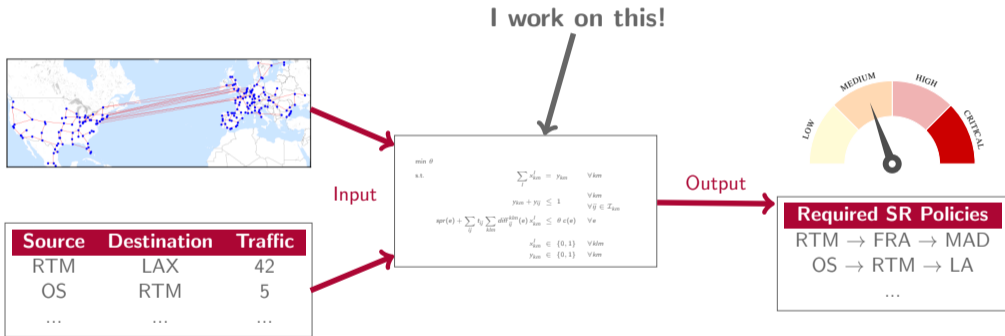
- ▶ Technical foundations exist! (*Midpoint Optimization, IGP Shortcut, Autoroute*)  
They are just **not used** (in literature).

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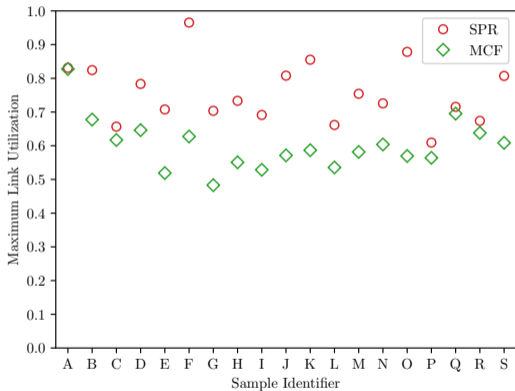
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## Central research aspects:

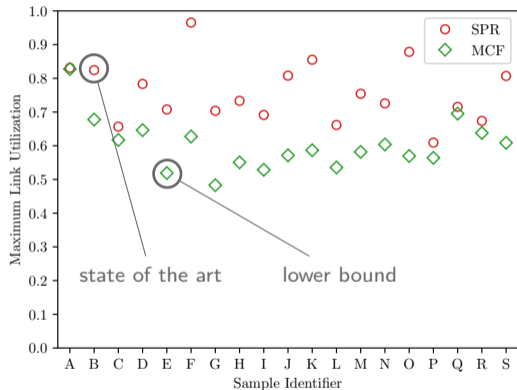
- ▶ **Solution Quality**  
→ Similar to end-to-end SR?
- ▶ **Policy Numbers**  
→ Reduction of SR policies in practice?
- ▶ **Algorithmic Complexity**  
→ Computation time & resource demands

## Tier-1 ISP Backbone Network:



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

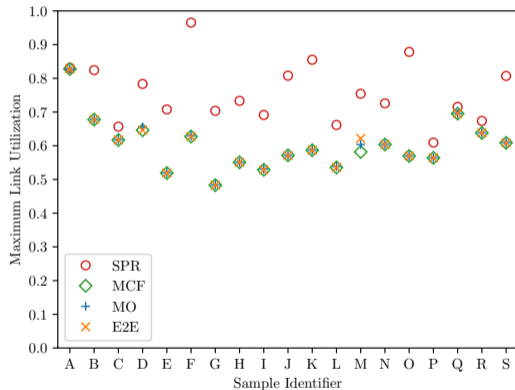
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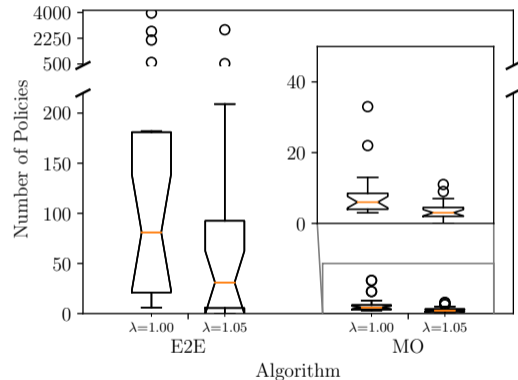
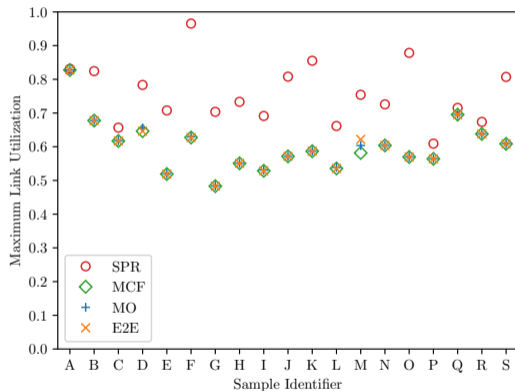
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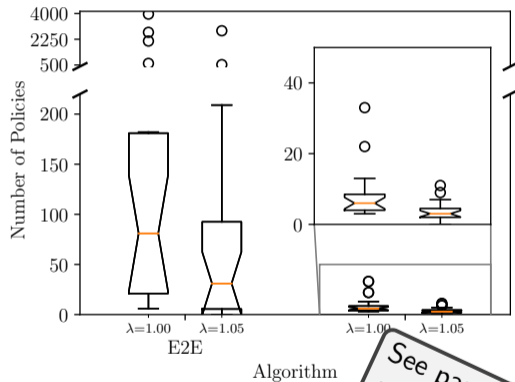
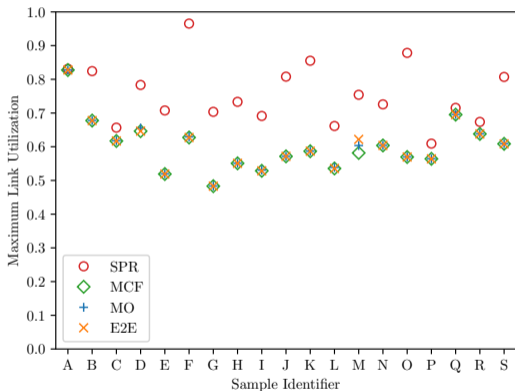


► MO on par with E2E SR.

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See paper for more results!

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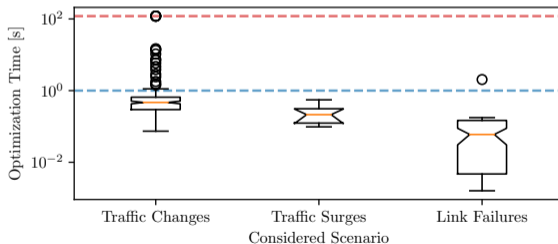
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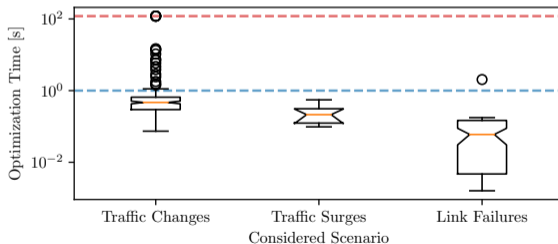


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Time's up? Find me at  
<https://sys.cs.uos.de/brundiers/>  
or contact me directly:  
[brundiers@uos.de](mailto:brundiers@uos.de)

**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.

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