

(IGP) Shortcuts Towards More Resilient Networks: Enhancing Proactive Protection & Reactive Restoration using Segment Routing Midpoint Optimization

Alexander Brundiers

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Common Problems in ISP Backbones:



Hardware Failures & Traffic Changes

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Hardware Failures & Traffic Changes Service Deterioration or Disruption

Common Problems in ISP Backbones: "Mom, the Internet is broken!!!"



Hardware Failures & Traffic Changes

Service Deterioration or Disruption

Unhappy Customers

This can be addressed with Traffic Engineering!

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

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Terminology:

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

A) Proactive Protection

Idea: "Hedge networks against said events so they don't become a problem."

"Preparation is the key to success!" — A. G. Bell

Schüller et al., "Failure Resiliency with only a few Tunnels – Enabling Segment Routing for Traffic Engineering", IEEE/ACM ToN, 2021

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B) Reactive Restoration

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Problem: Current approaches only utilize SR in end-to-end fashion! Requires dedicated policy for each traffic demand to be detoured.

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→ Limitations regarding the practical usability of reactive restoration!

How to overcome these issues?

Problem: Dedicated "demand-bound" policies



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 \rightarrow Detouring of multiple demands with only a single policy!

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Our algorithm resolves over 99% of failure scenarios, mostly in sub-second fashion!



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Fast computation, verification & provisioning → Greatly improved "Time-to-Repair"!

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Bridging the Gap: Theory \rightarrow Practice



Important Constraints & Requirements

- Policy Numbers
- Routing Loops

- MSD Limits
- Traffic Splitting

• Latency Bounds

• ...





Important Constraints & Requirements



What's next?

Combining both approaches into one fleshed out system:



The Takeaway

SR Midpoint Optimization (greatly) improves ...

- Proactive Protection
 - Better "coverage" (i.e. more scenarios/events)
- Reactive Restoration
 - Sub-second computation of required changes
 - Considerably lower provisioning times (due to fewer changes)

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Time's up? Find me at

sys.cs.uos.de/bruadiers

or contact me directly:

brundiers@uos.de

Appendix & Backup-Slides

Image Sources/Credits

- The "scientist tux" (penguin) on Slide 3 is taken from: M. Barbieri, 2010, "Tux version of scientist Lazzaro Spallanzani", Wikimedia Commons. online: https://commons.wikimedia.org/wiki/File:Tux_Spallanzani.svg License: Massimo Barbieri, CC BY-SA 3.0 https://creativecommons.org/licenses/by-sa/3.0, via Wikimedia Commons
- Some of the illustrations on Slide 2 were created using the AI Image Generator of DeepAI (https://deepai.org/machine-learning-model/text2img)