Improving Network Availability with Protective ReRoute

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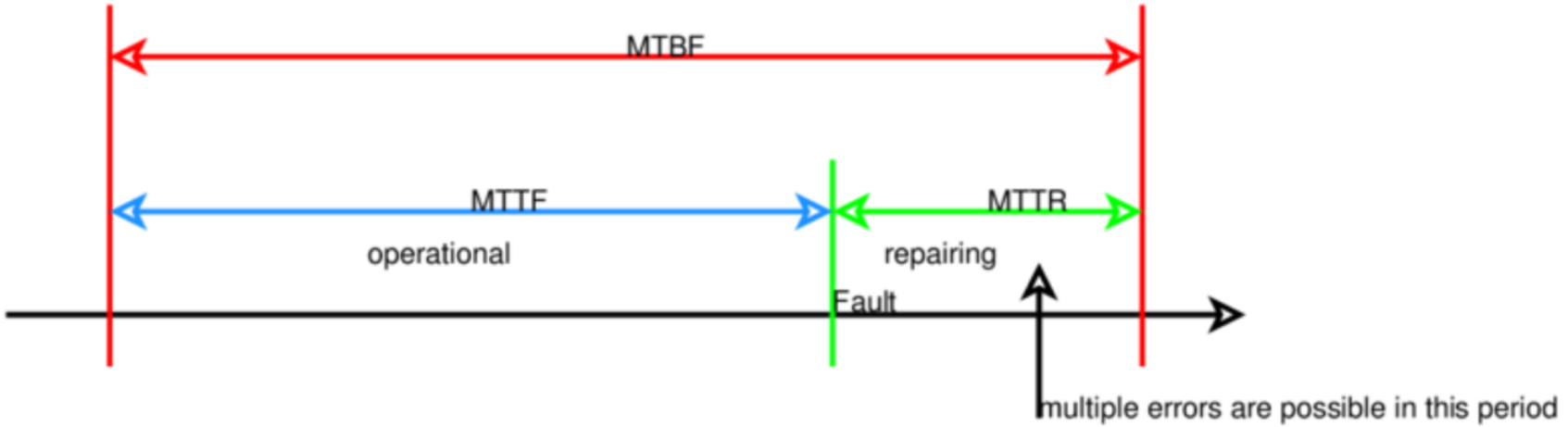
What is our goal?



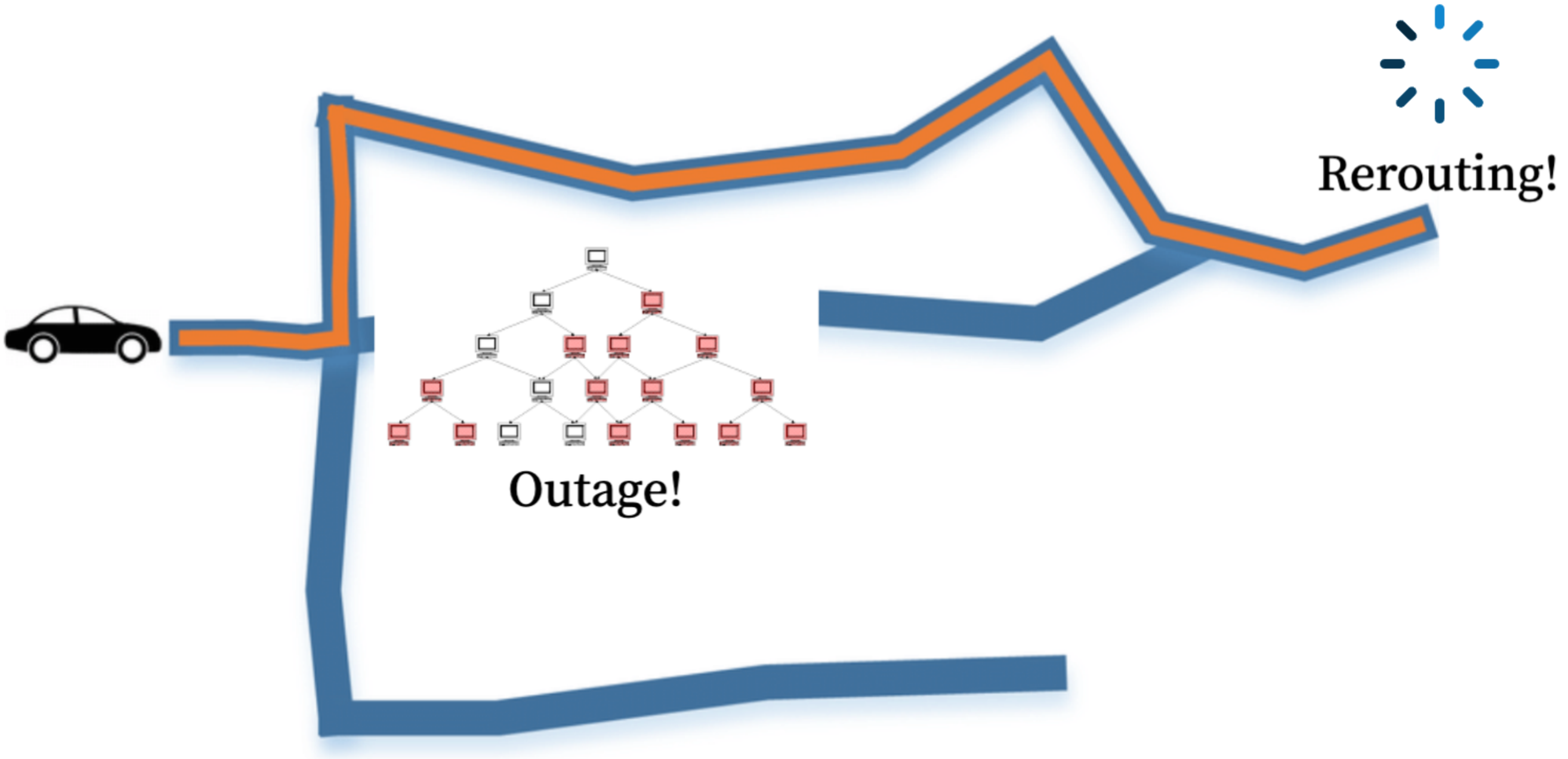
$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$$

Keep MTBF large

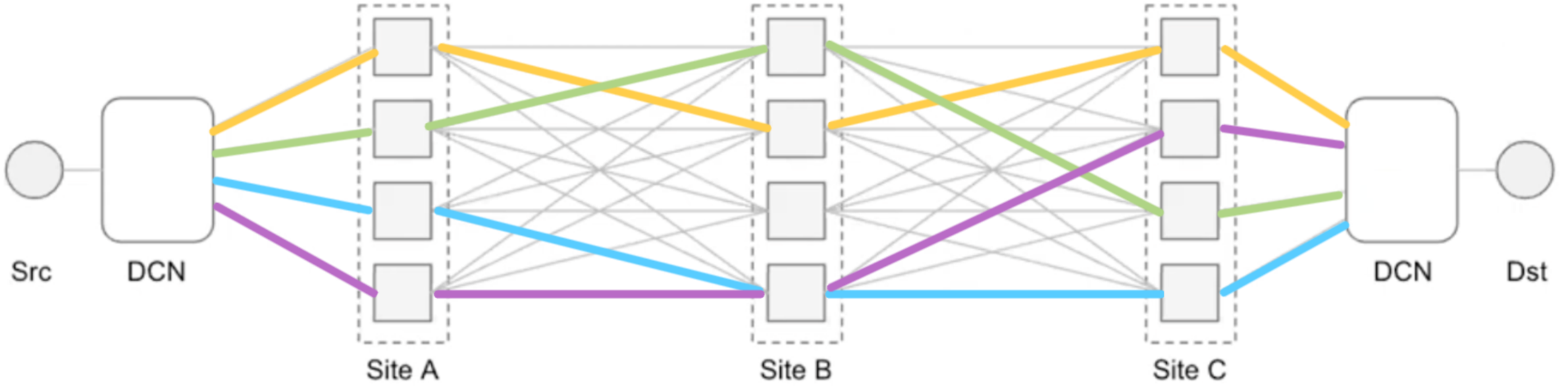
Foucs on MTTR

MTBF is the Mean Time Between Failures
MTTR is the Mean Time to Repair

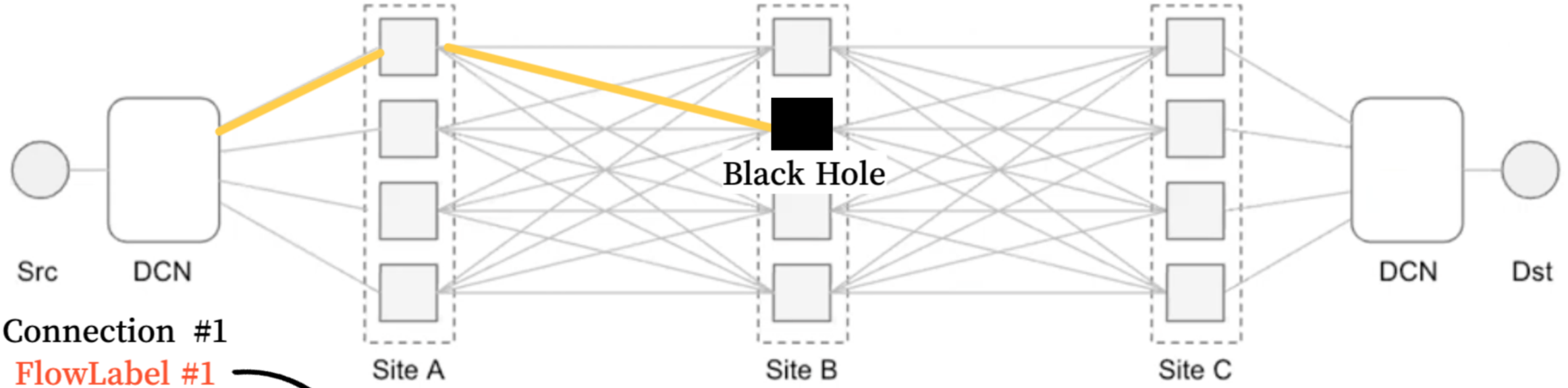
What is Protective ReRoute?



What is Protective ReRoute?

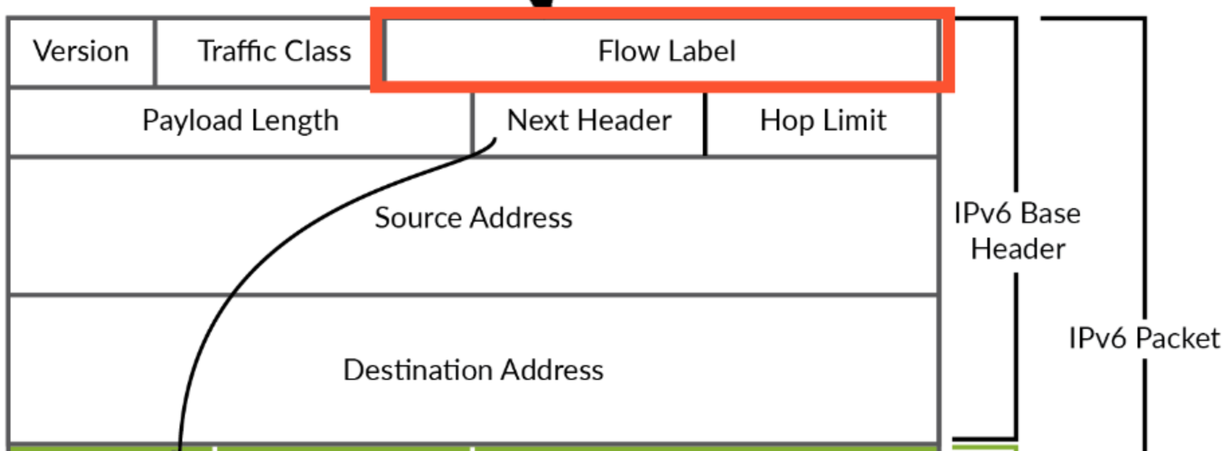


What is Protective ReRoute?



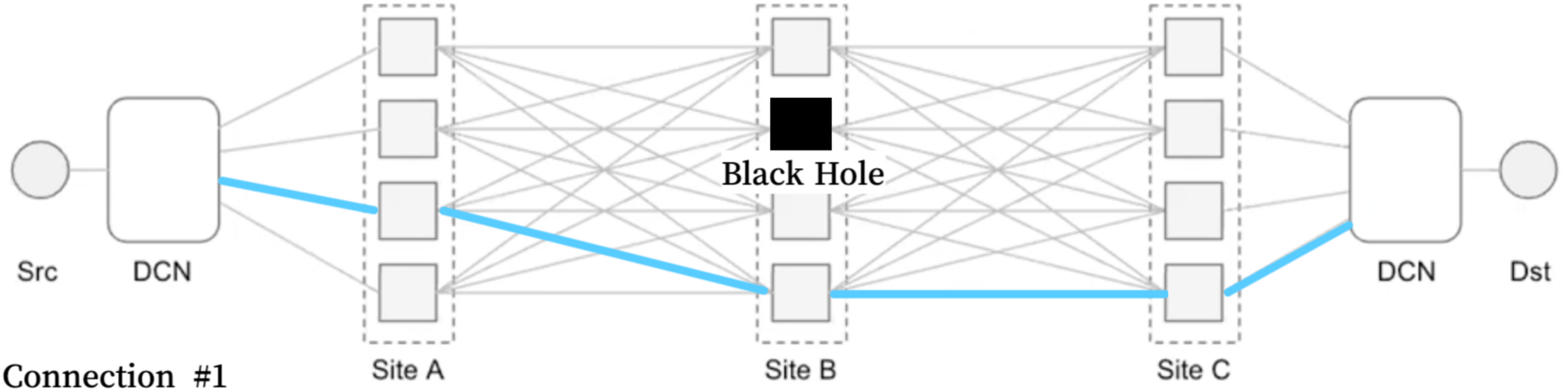
Connection #1

FlowLabel #1



FlowLabel #1

What is Protective ReRoute?

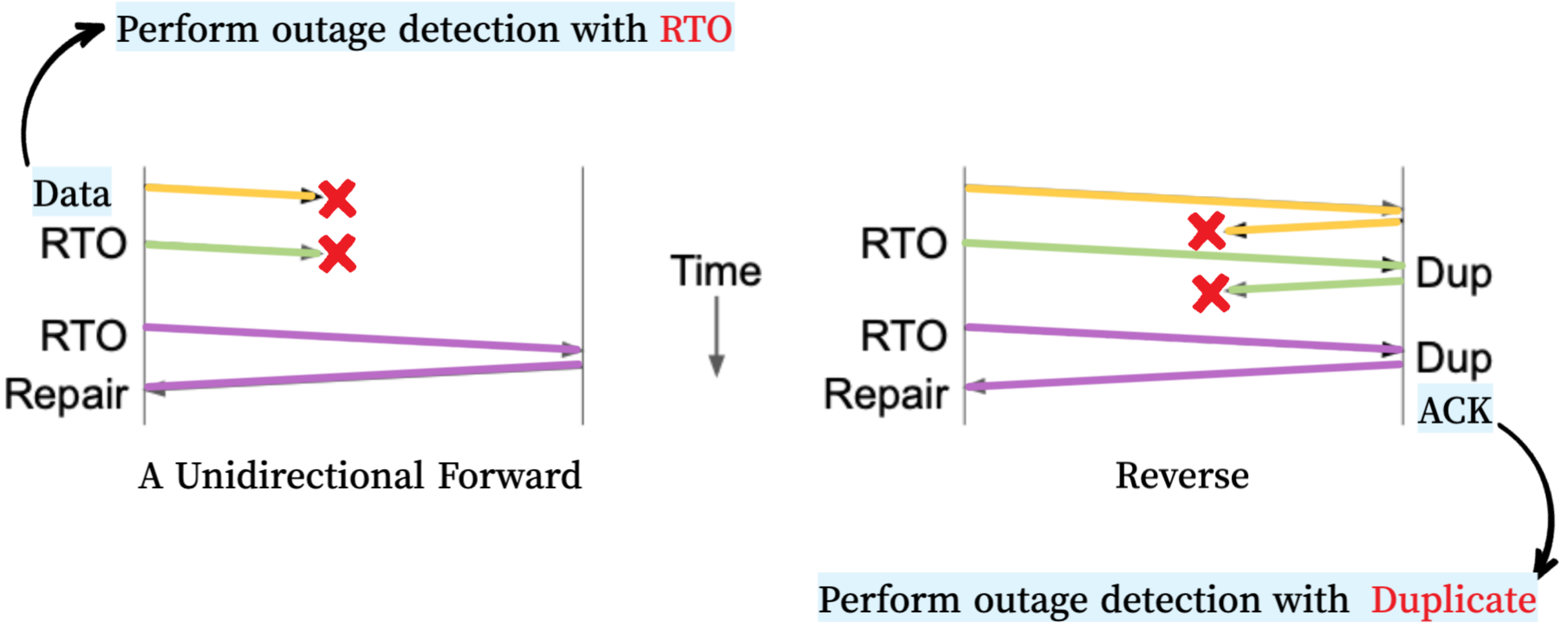


Connection #1
FlowLabel #3

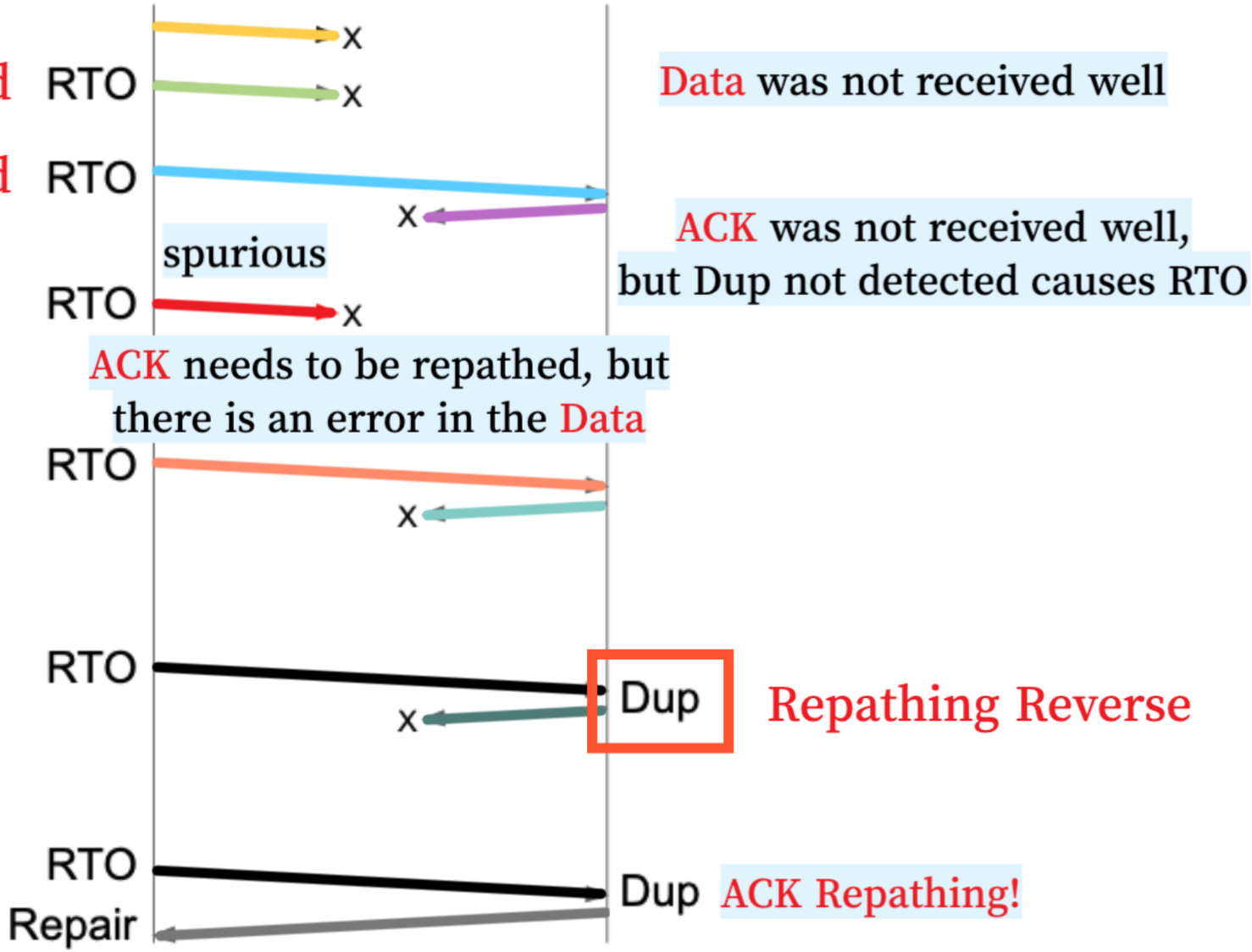
Without Added Overhead!

FlowLabel #1
FlowLabel #3

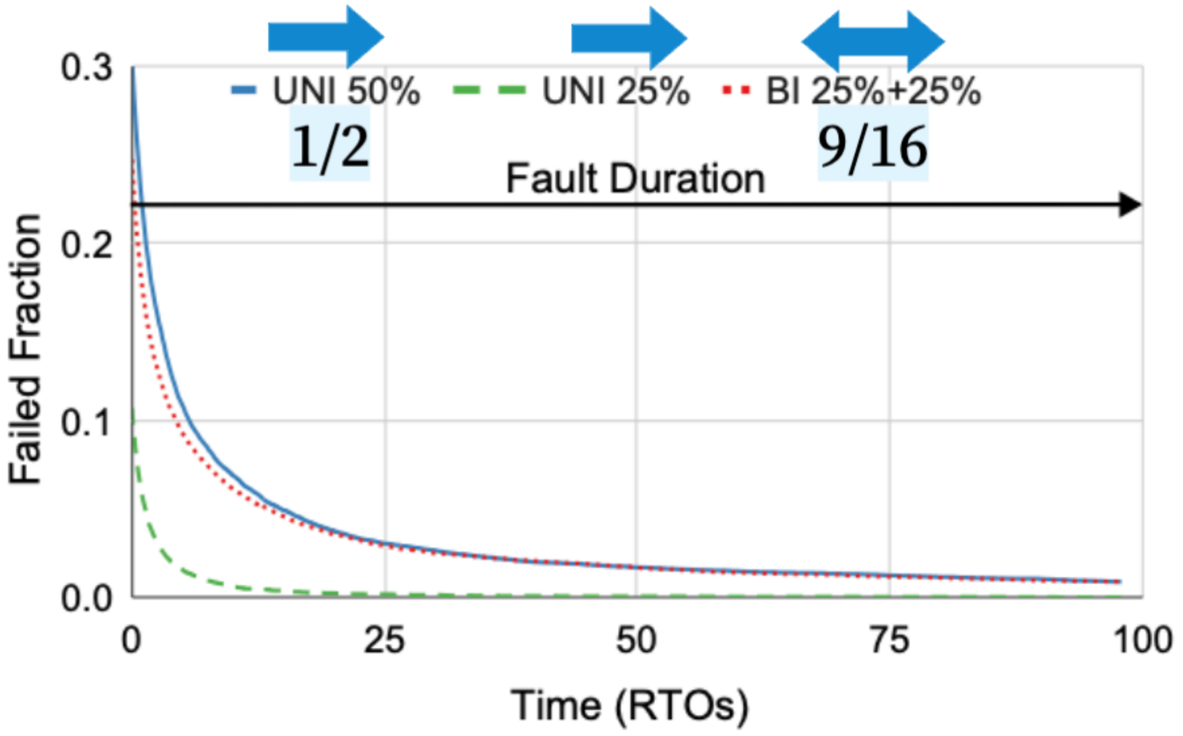
Types of Recovery

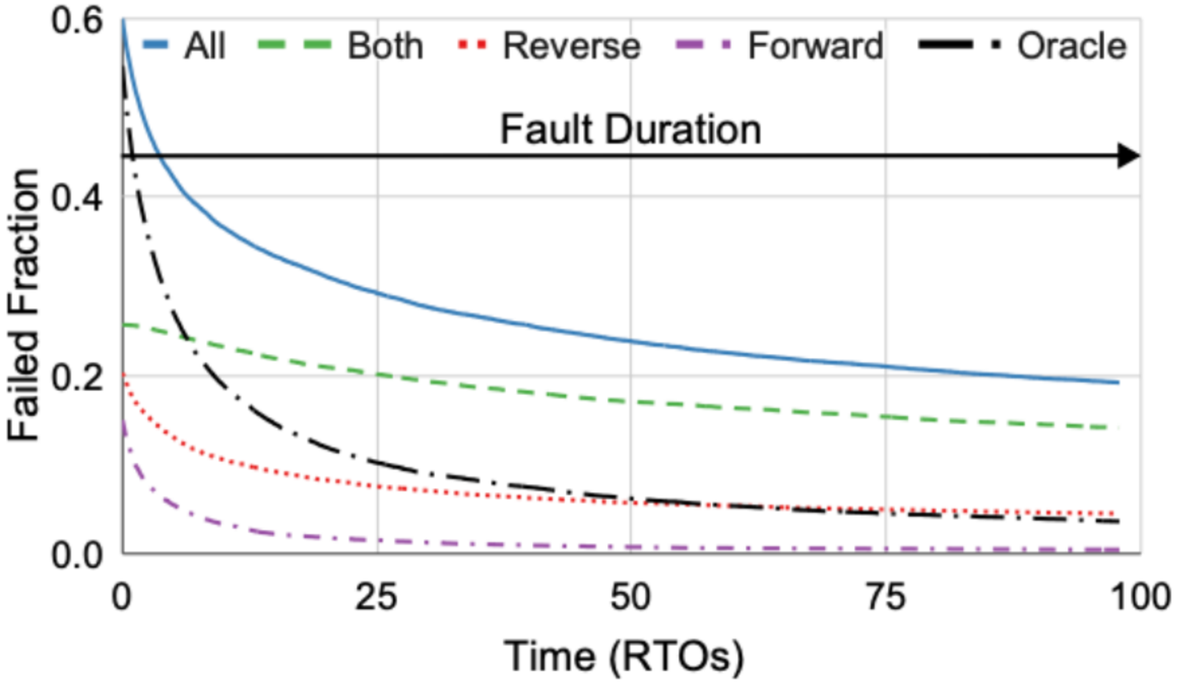


Repathing Example



Outage fraction by fault type



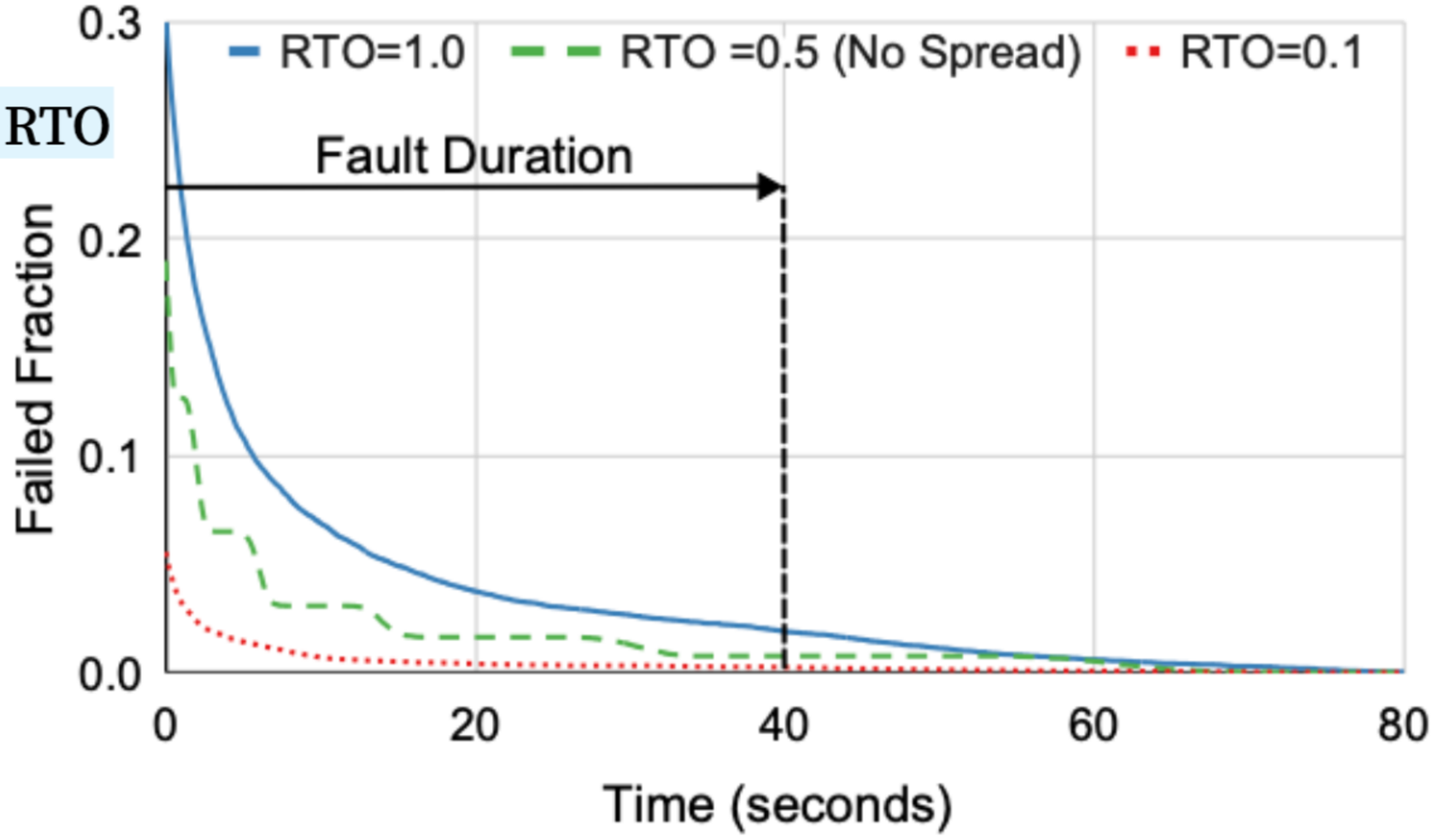


Promotes recovery over time

RTO effect

- the repair of a 50% outage

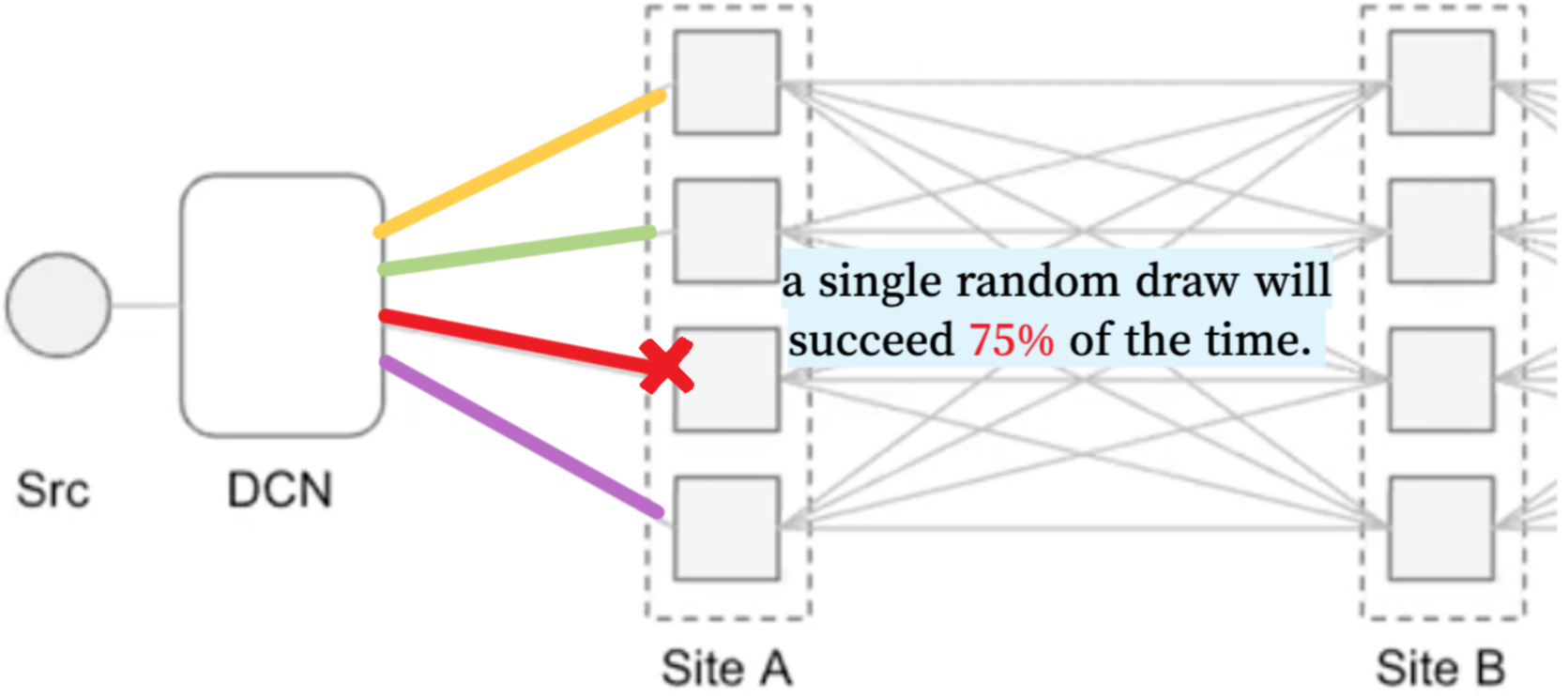
Recovered before RTO



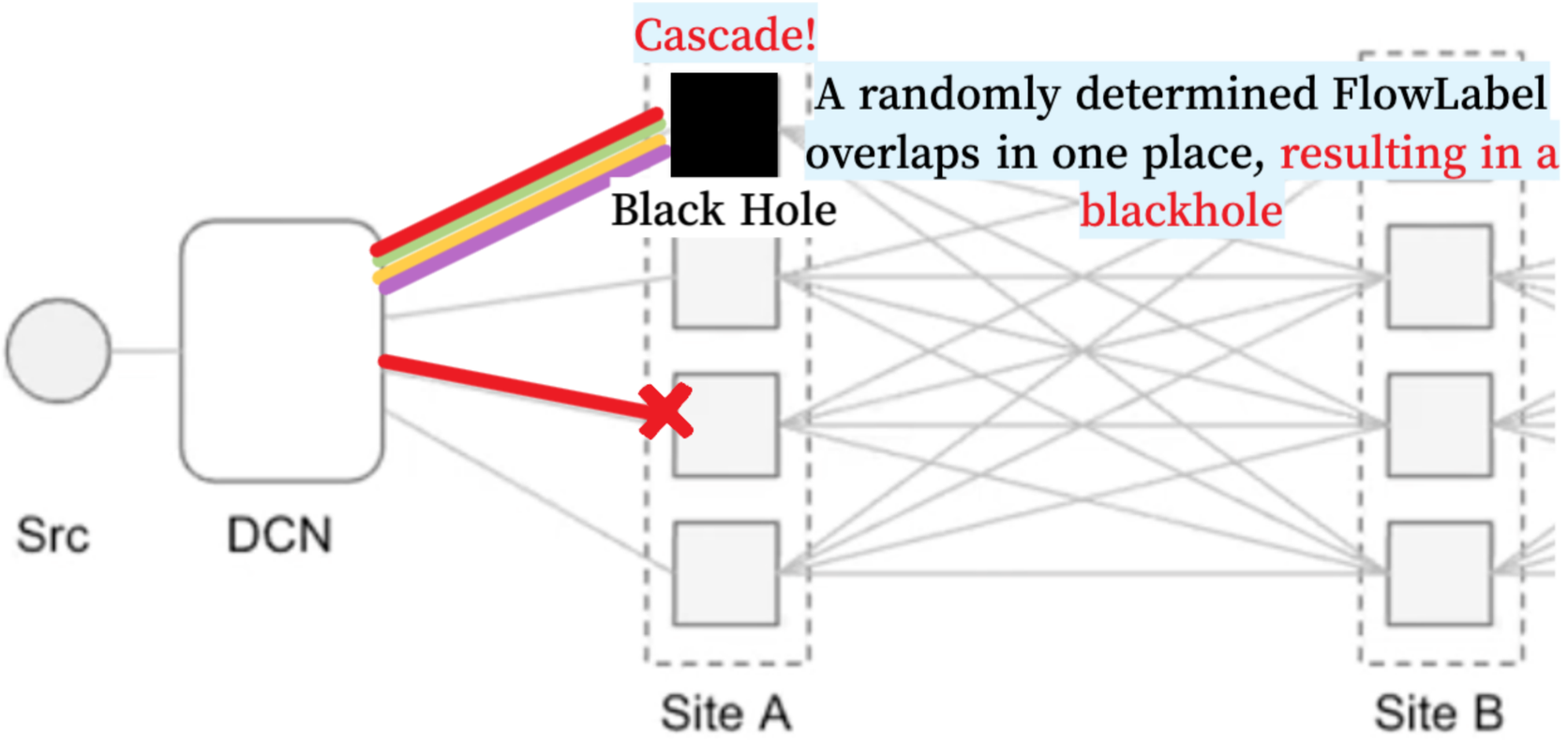
The lower the RTO, the more repathing can be performed per unit time.

Random Repathing

- PRR repaths as a local action by using the FlowLabel

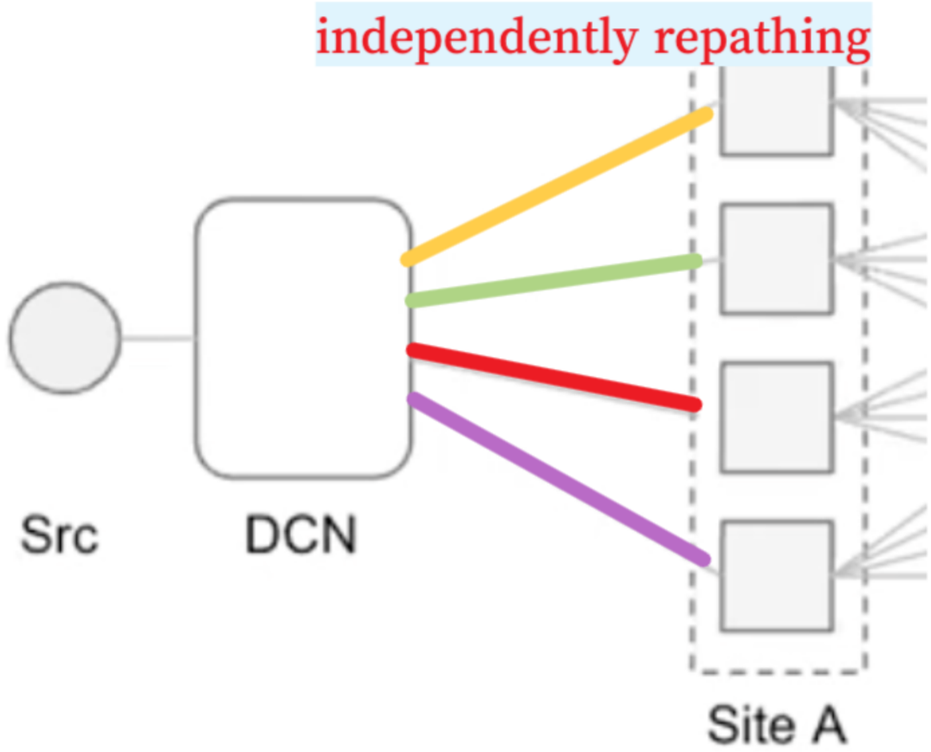


Random Repathing Cascade



PRR shifts traffic more gradually and smoothly

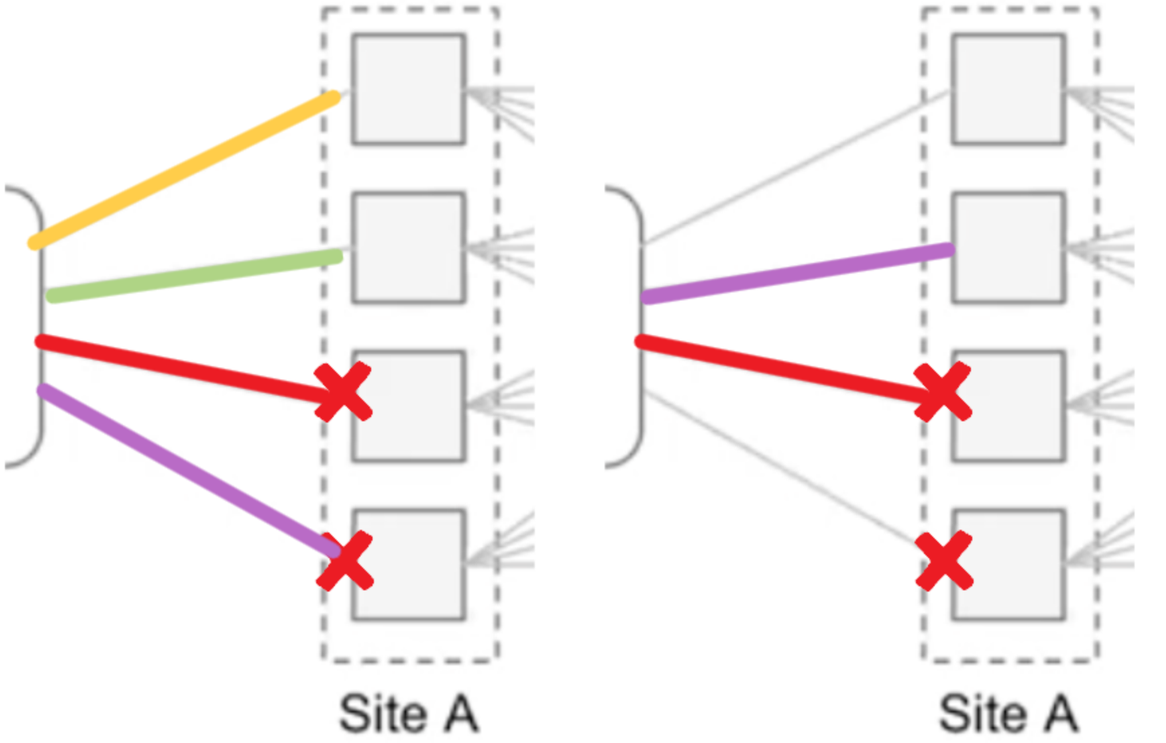
How do gradually?



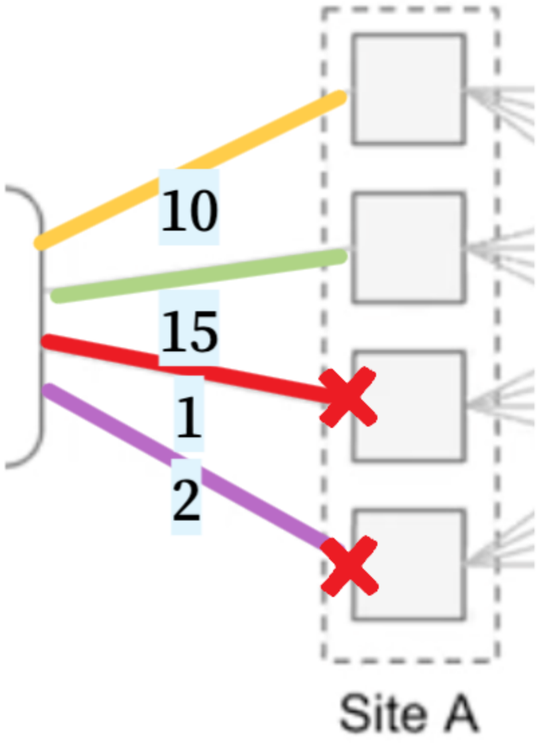
spreads reaction times out at RTO timescales

How do smoothly?

- 50% outage



2X the origin overhead

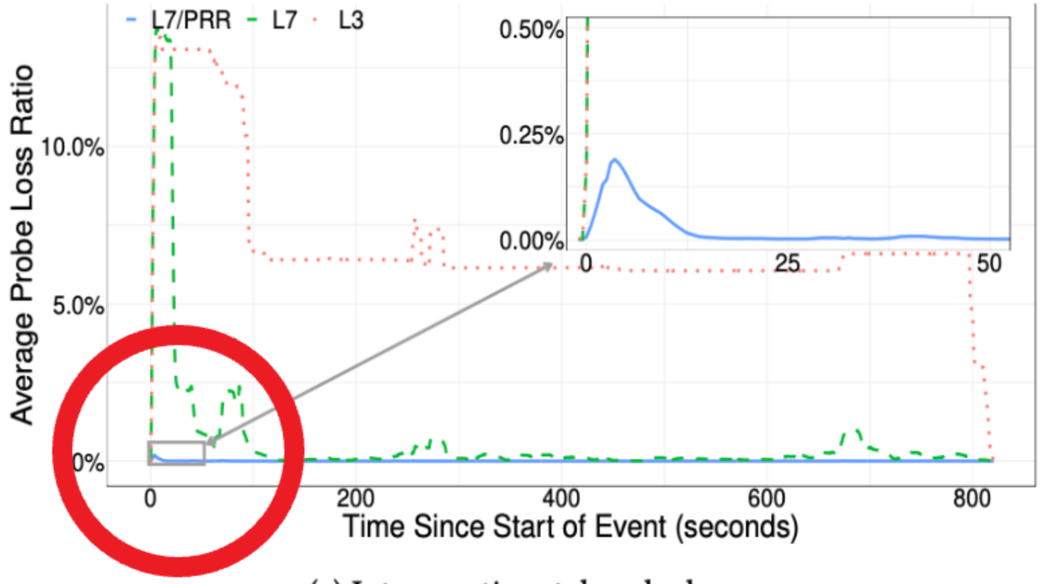


random repathing using routing weights

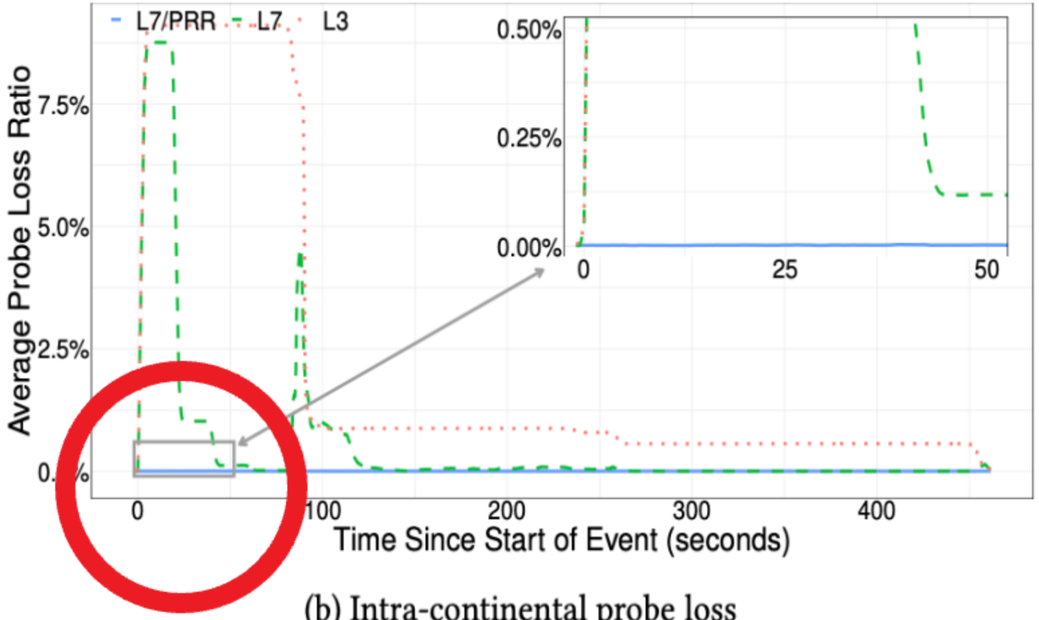
PRODUCTION RESULTS

- Case Study 1: Complex B4 Outage

※ L3 : Network Layer, L7 : Application Layer, L7/PRR : Enable PRR



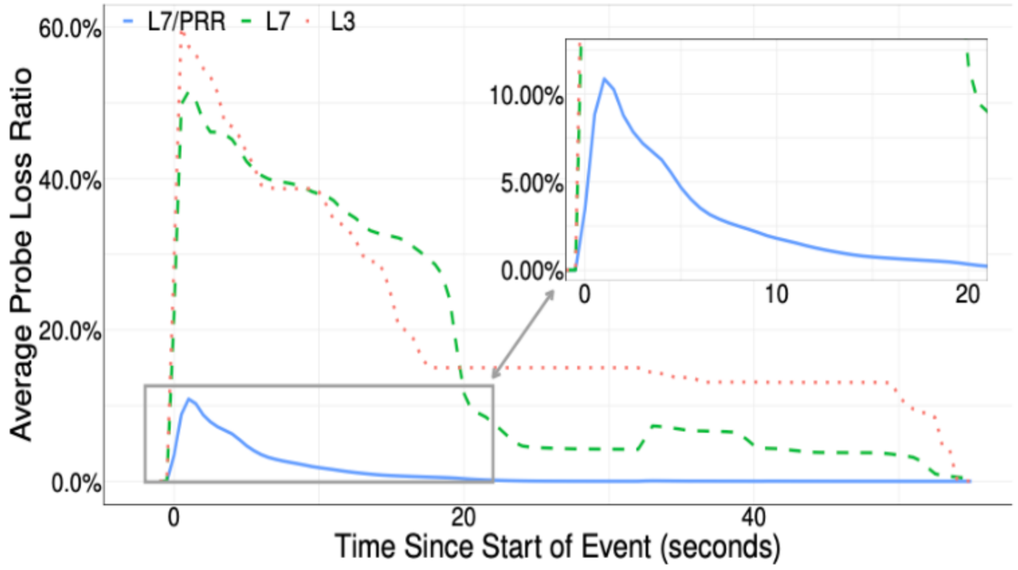
(a) Inter-continental probe loss



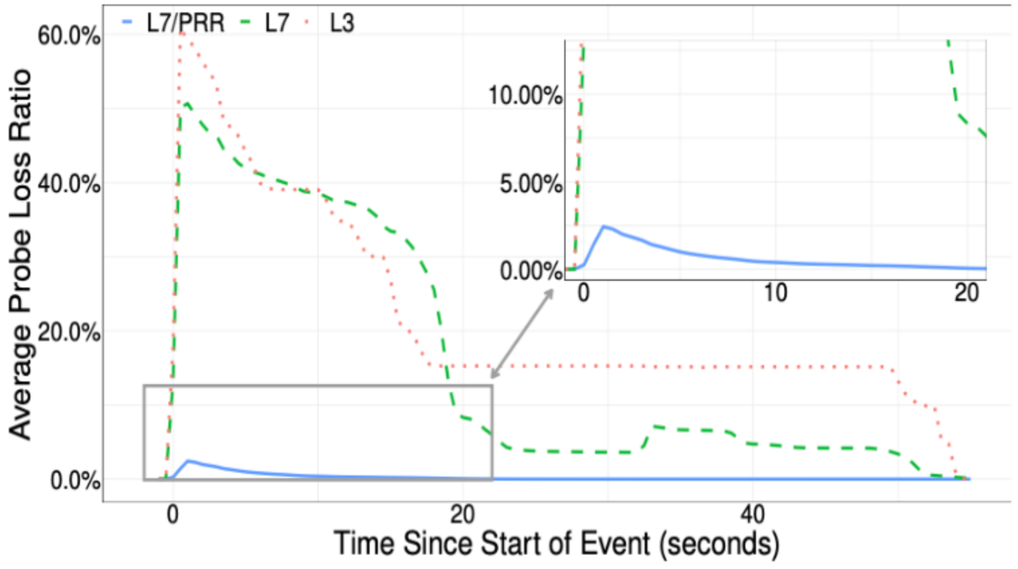
(b) Intra-continental probe loss

PRODUCTION RESULTS

- Case Study 2: Optical failure



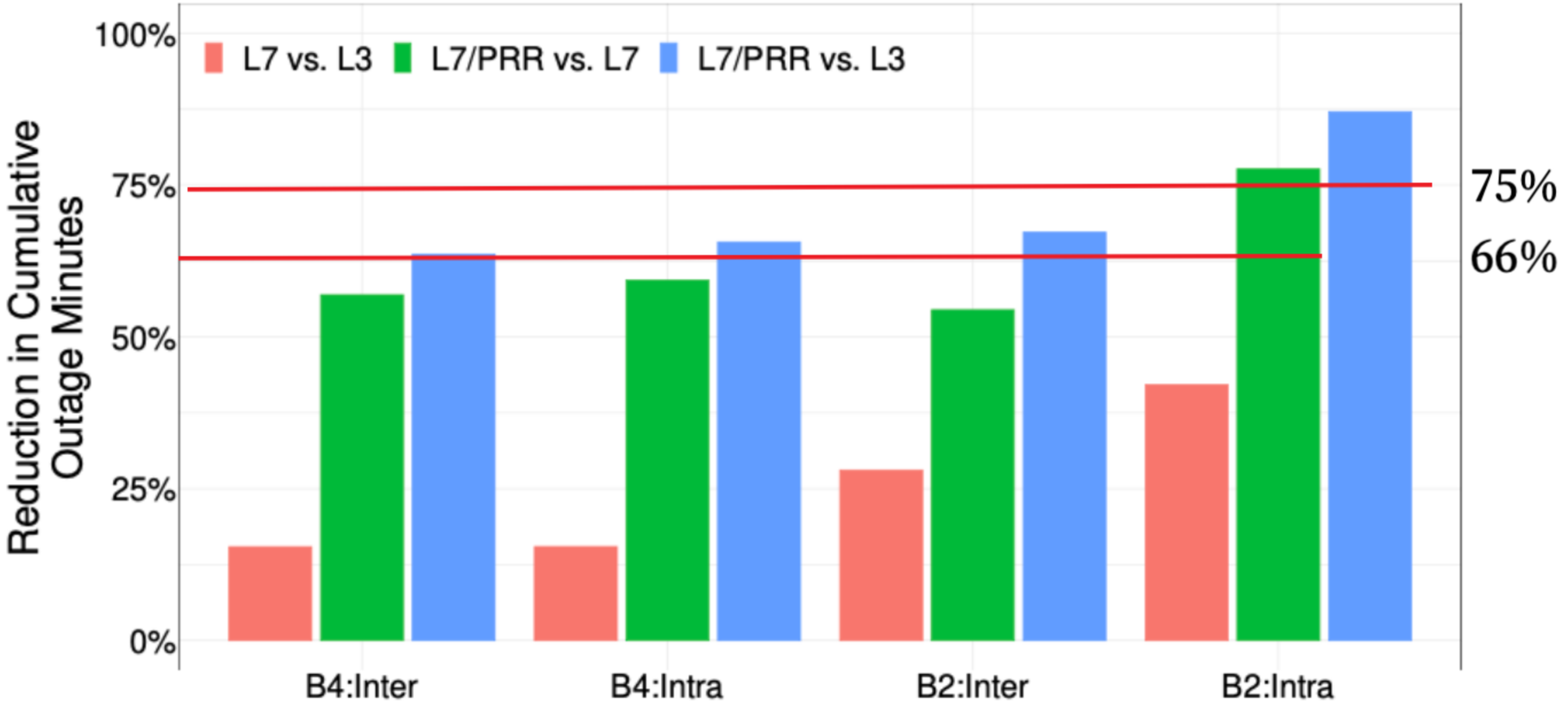
(a) Inter-continental probe loss



(b) Intra-continental probe loss

Aggregate Improvements

- Outage minute



Conculsion

- Use IPv6 FlowLabel for ECMP
- Use routing to maintain diverse paths
- Use host repathing for repair, not FRR

Thank You