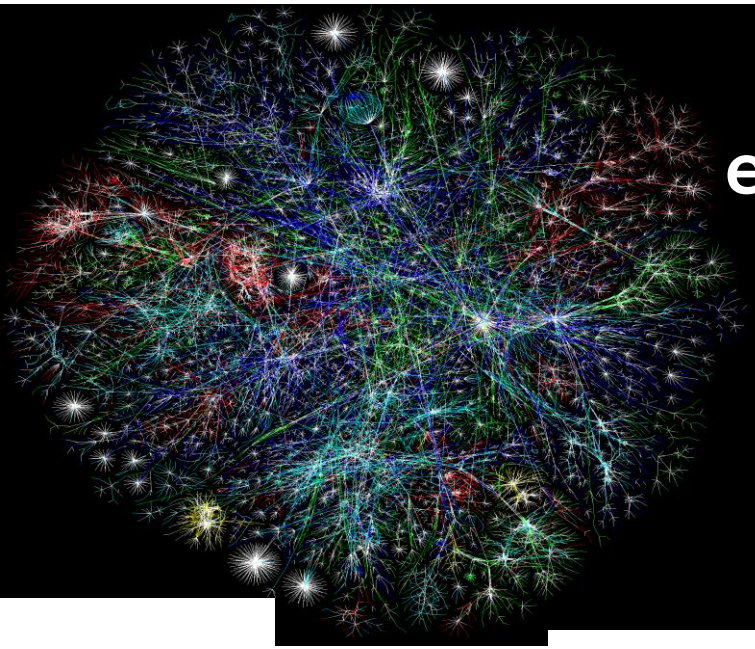

Measuring and characterizing end-to-end route dynamics in the presence of load balancers

Ítalo Cunha

Renata Teixeira

Christophe Diot

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Our understanding of route dynamics is outdated

Paxson's seminal study of routing dynamics from the late 90's

- Focused on route duration and route prevalence
- Found that Internet routes are mostly stable but have instability periods
- Found that source-destination pairs have a prevalent route

Network operational practices have changed

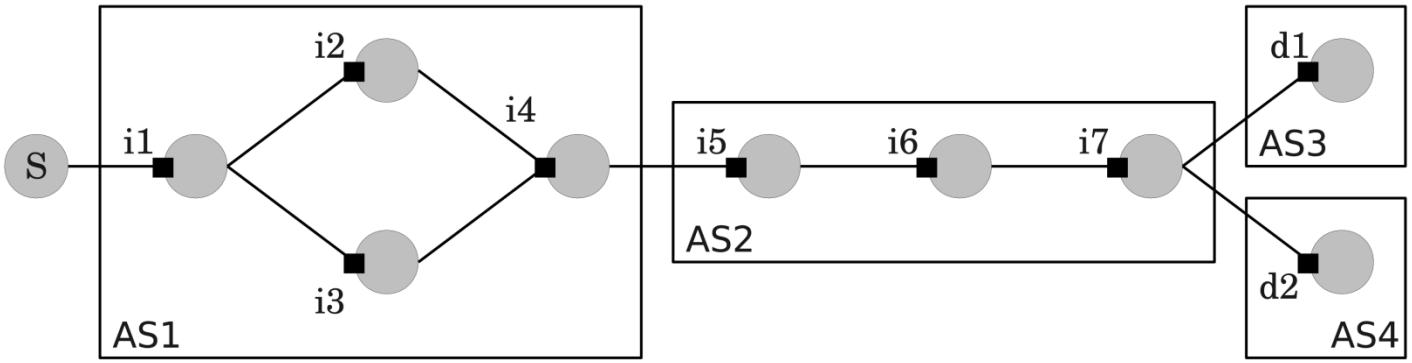
- Load balancing
- Multi homing
- Tunneling

Route dynamics and load balancing

Load balancing != routing dynamics

- Routing tables do not change
- Forwarding decision changes

Load balancing may look like routing dynamics



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How to measure route dynamics?

Measuring route dynamics under load balancing is complex

- Paris traceroute's multipath detection algorithm requires many probes
- Hence, cannot probe routes fast enough to capture route dynamics

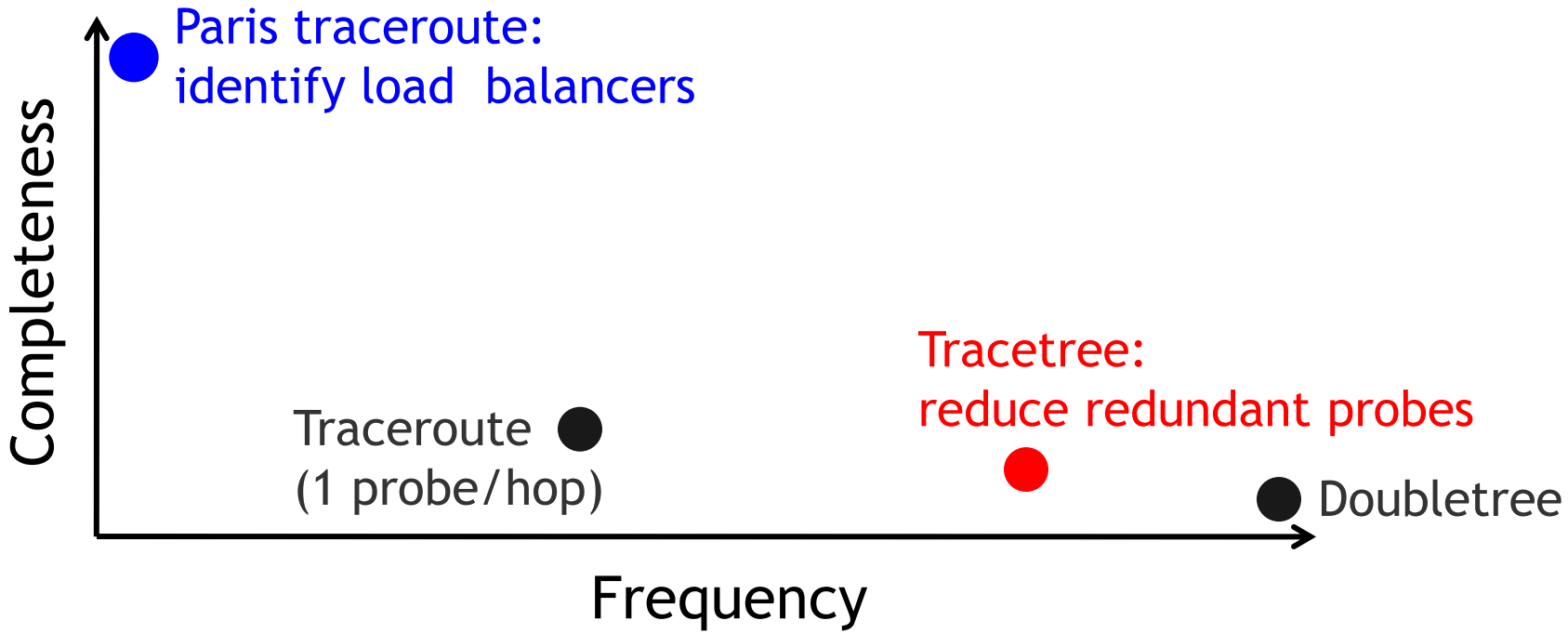
Contributions

Show the impact of load balancing on measurements of route dynamics

FastMapping: a probing strategy to measure route dynamics under load balancing

Reappraise Paxson's results

Methods to measure route dynamics



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Datasets to compare methods

23 PlanetLab hosts probing 1,000 destinations

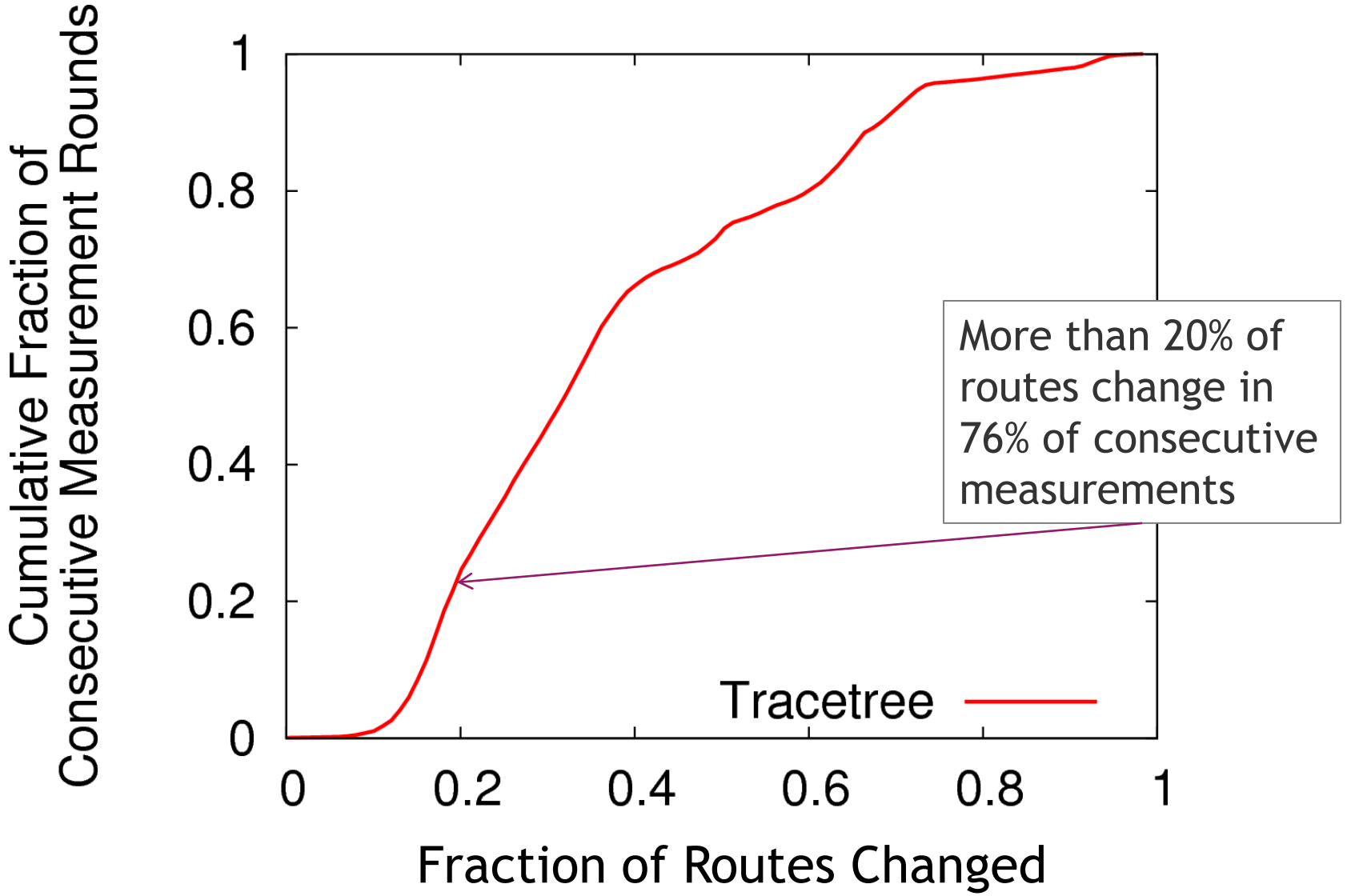
Tracetree and Paris traceroute (MDA)

1 week of data starting August 9th, 2010.

Routes measured every 28 minutes on average

Dataset covers 5,266 ASes and 95% of the large ASes

Load balancing introduces dynamics



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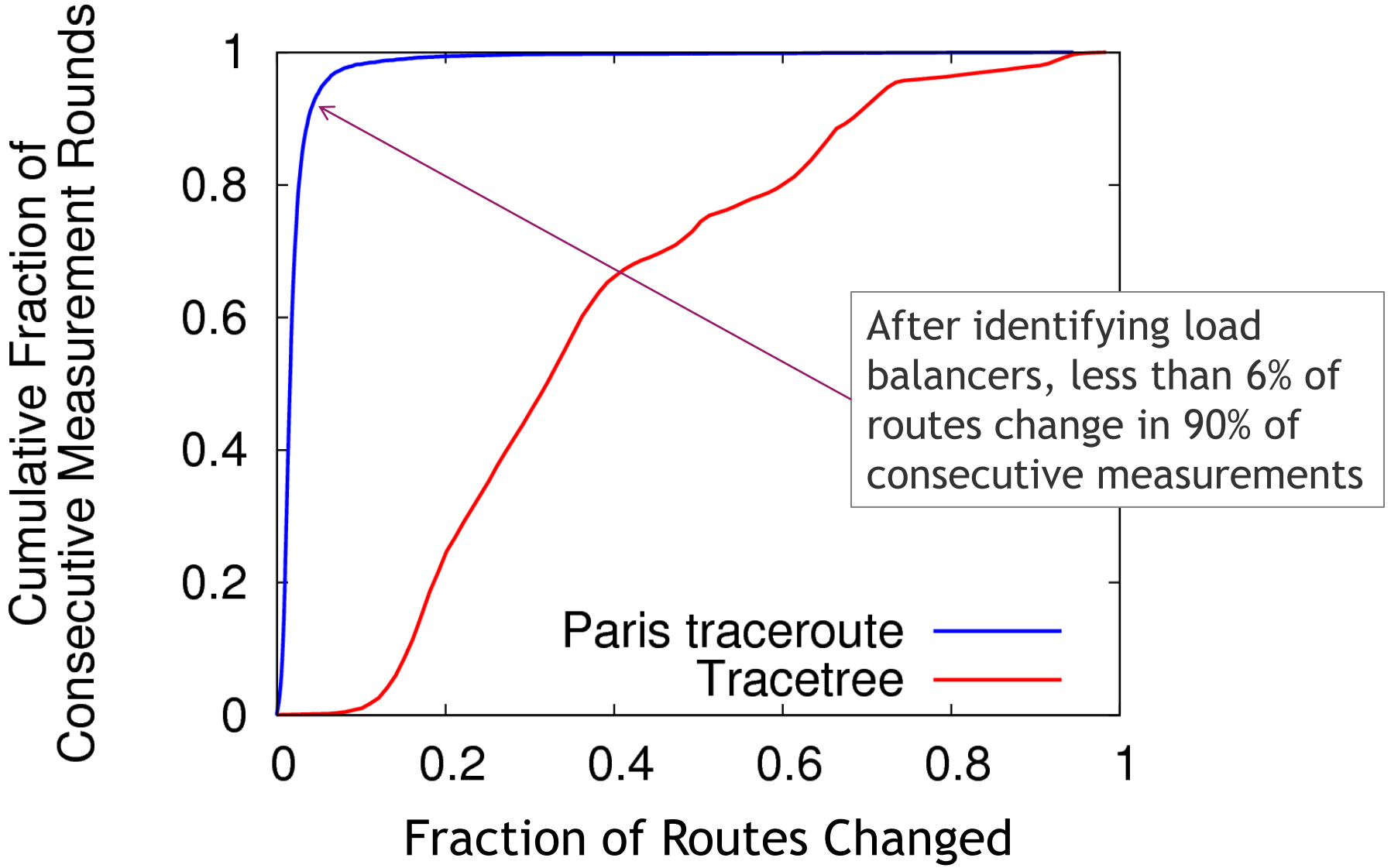
Load balancing introduces dynamics



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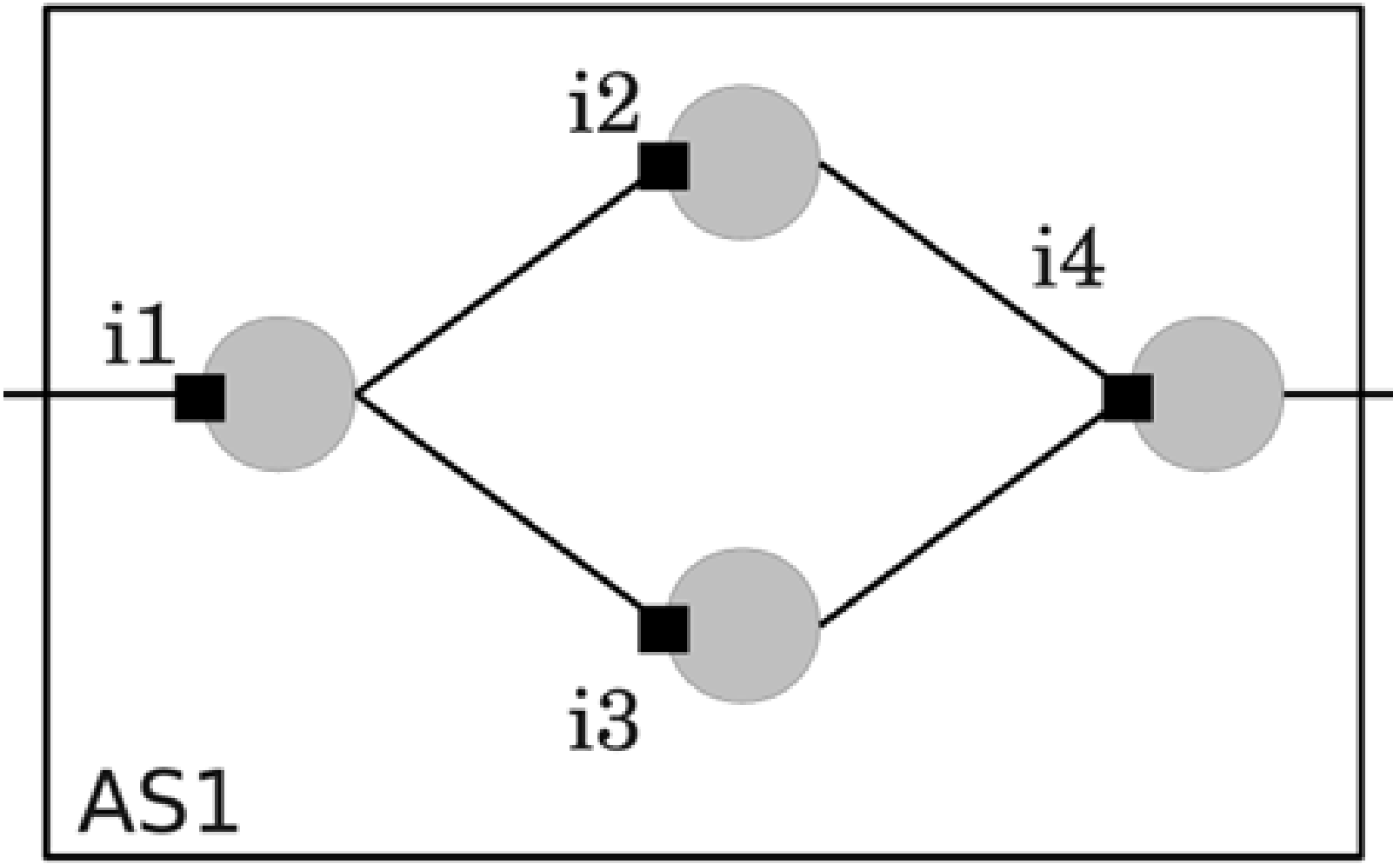
Contributions

Show the impact of load balancing on measurements of route dynamics

FastMapping: a probing strategy to measure route dynamics under load balancing

Reappraise Paxson's results

Load balancers don’t change frequently



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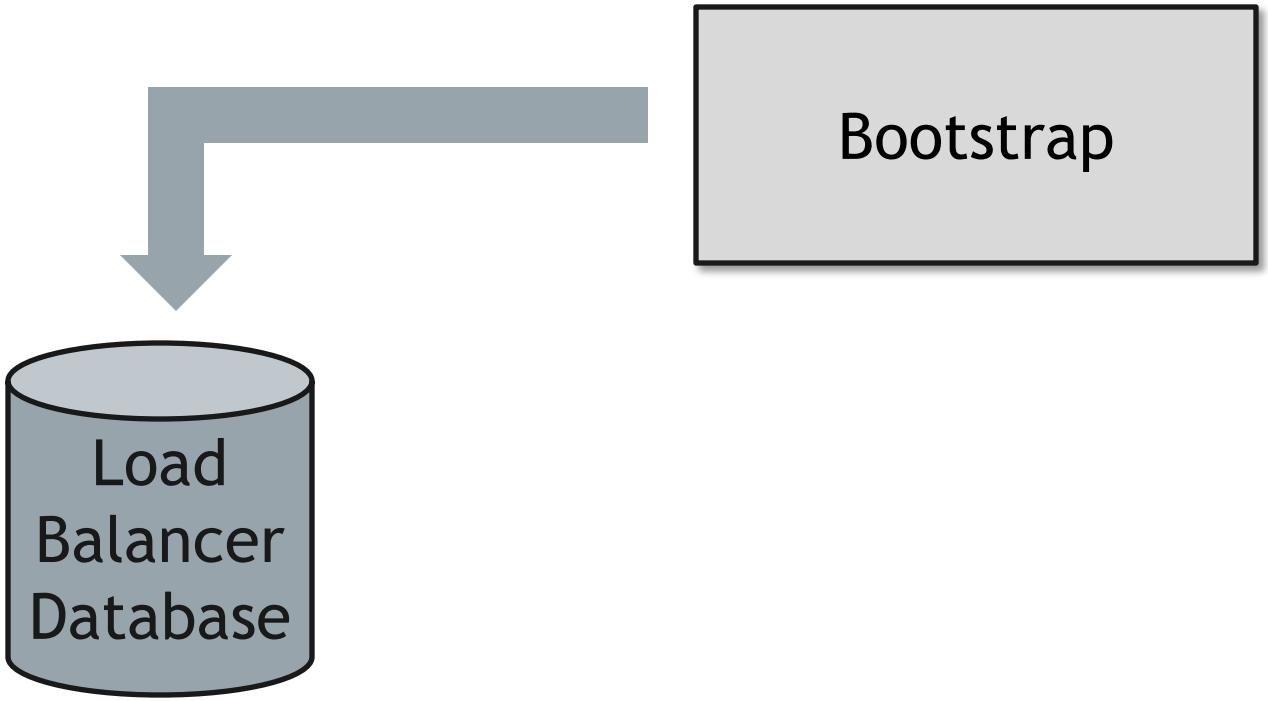
FastMapping: Complete ***and*** fast route probing



1. Paris traceroute multi-path detection

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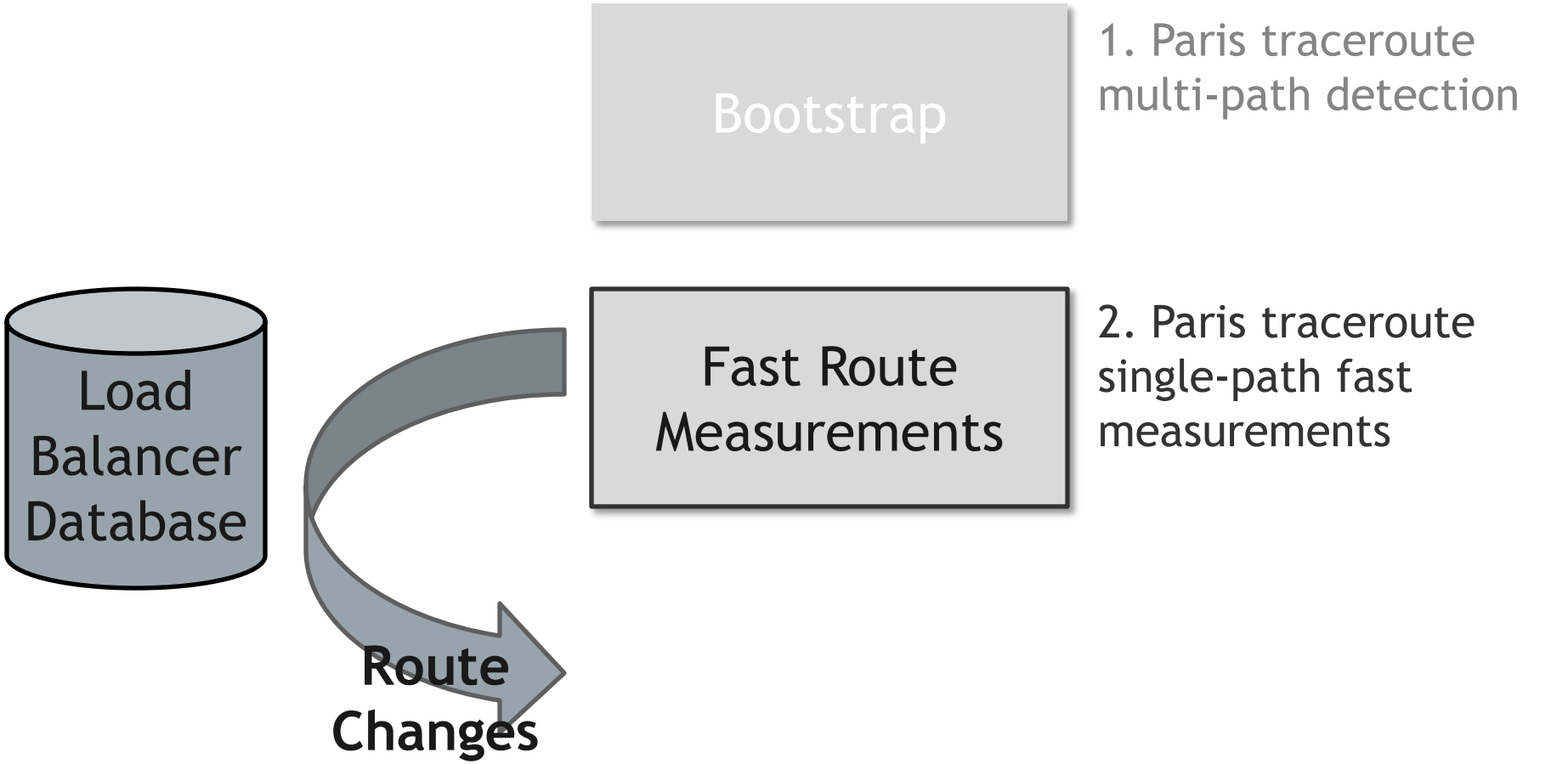
FastMapping: Complete ***and*** fast route probing



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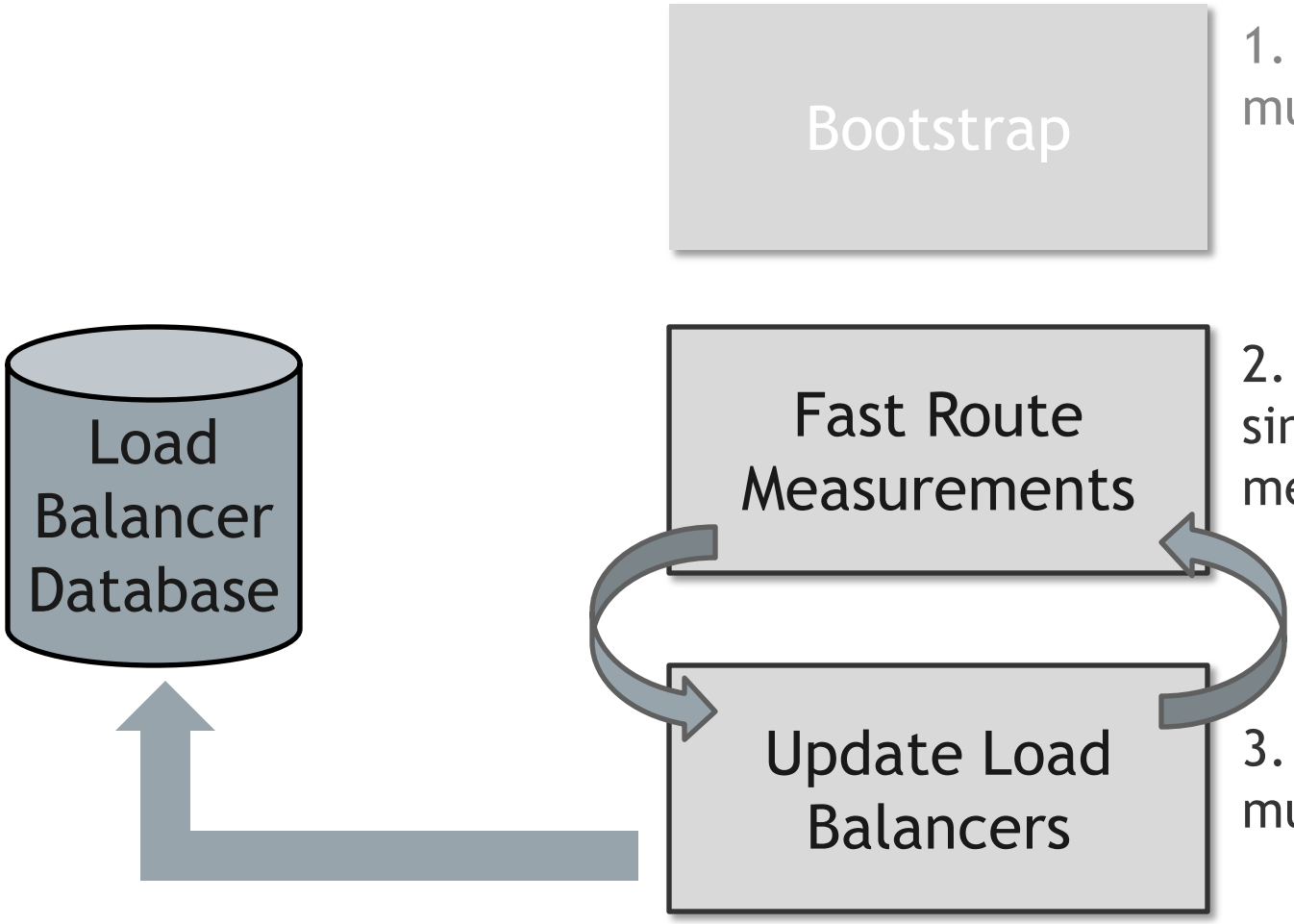
FastMapping: Complete ***and*** fast route probing



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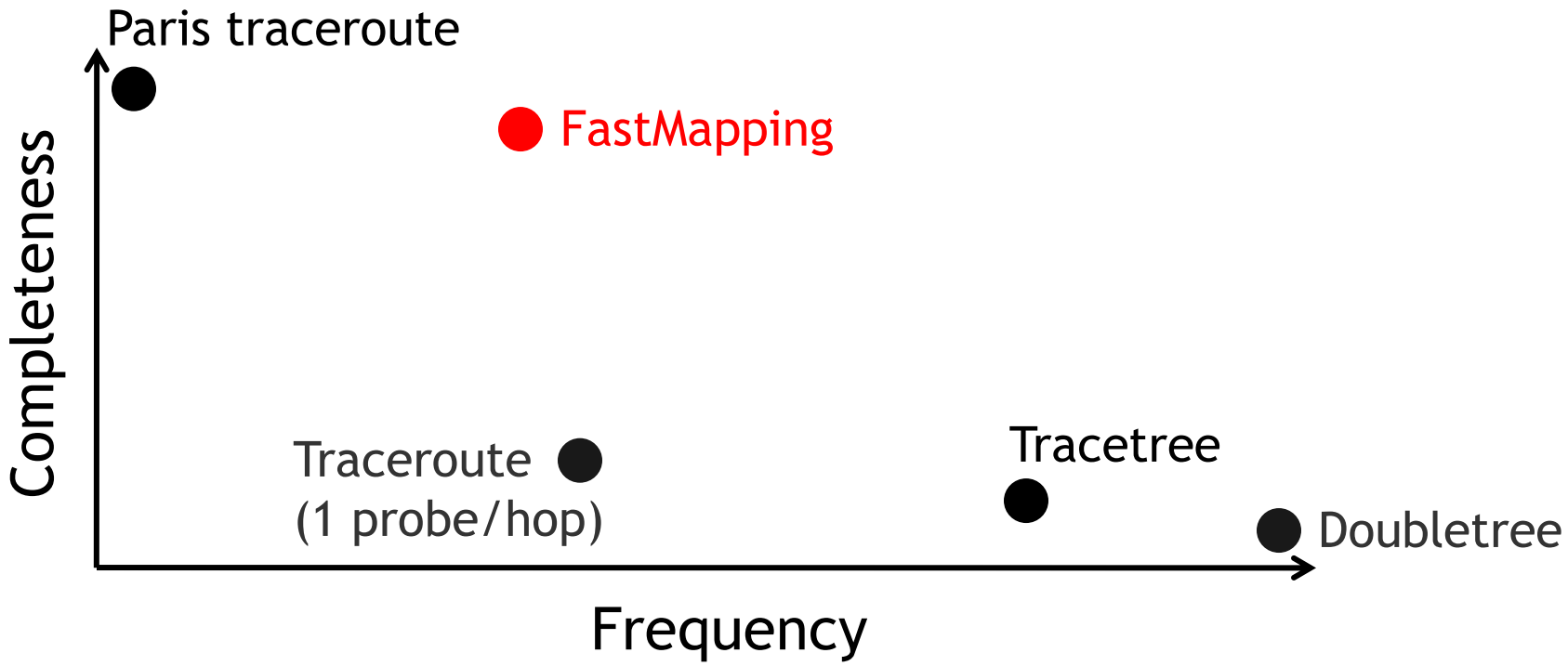
Methods to measure route dynamics



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Contributions

Show the impact of load balancing on measurements of route dynamics

Design a probing strategy to measure route dynamics under load balancing

Reappraise Paxson's results

FastMapping dataset

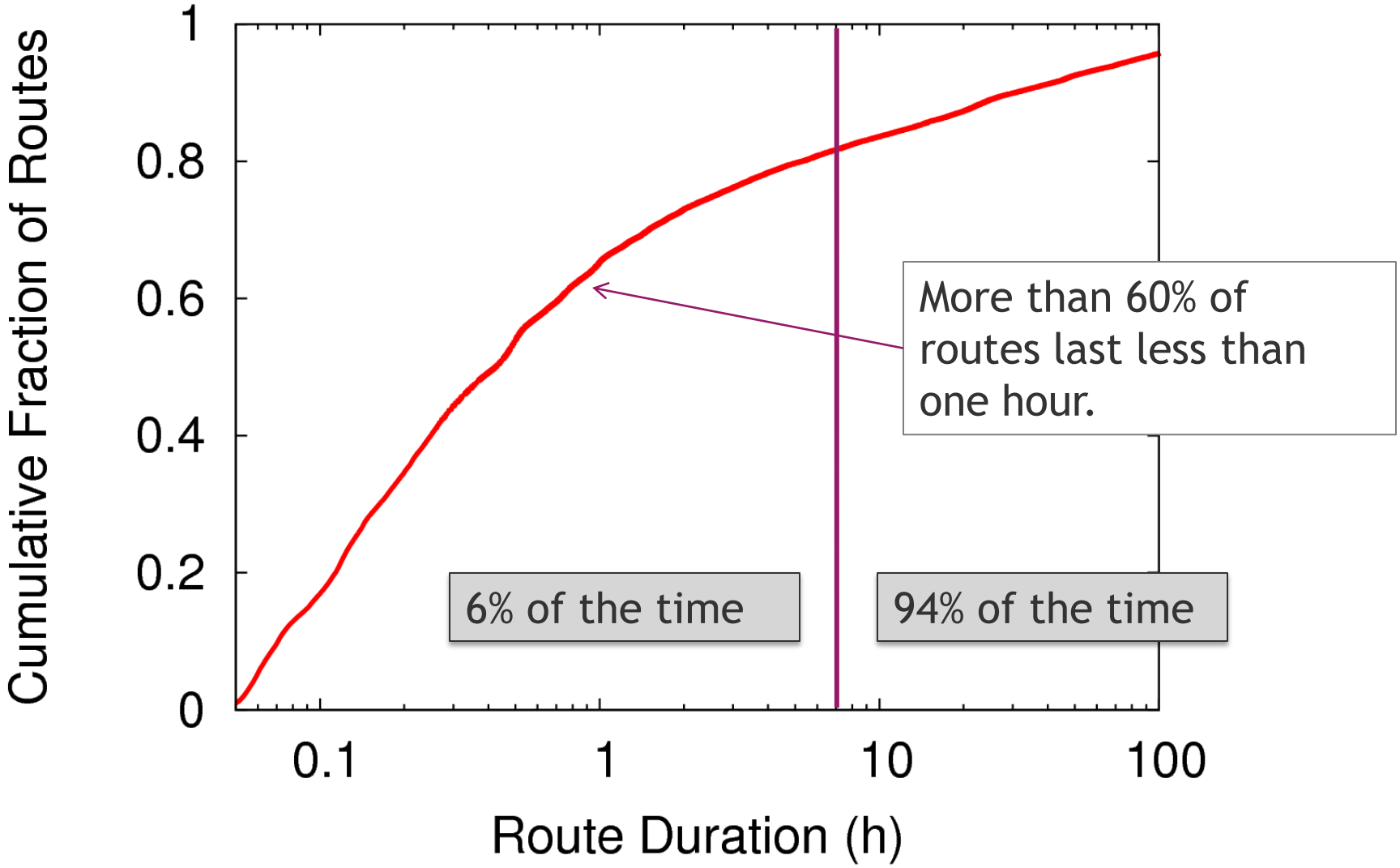
70 PlanetLab hosts probing 1000 destinations

5 weeks of data starting September 1st, 2010.

Routes measured every 4.4 minutes on average

Dataset covers 7942 ASes and 97% of the large ASes

Most routes have short duration



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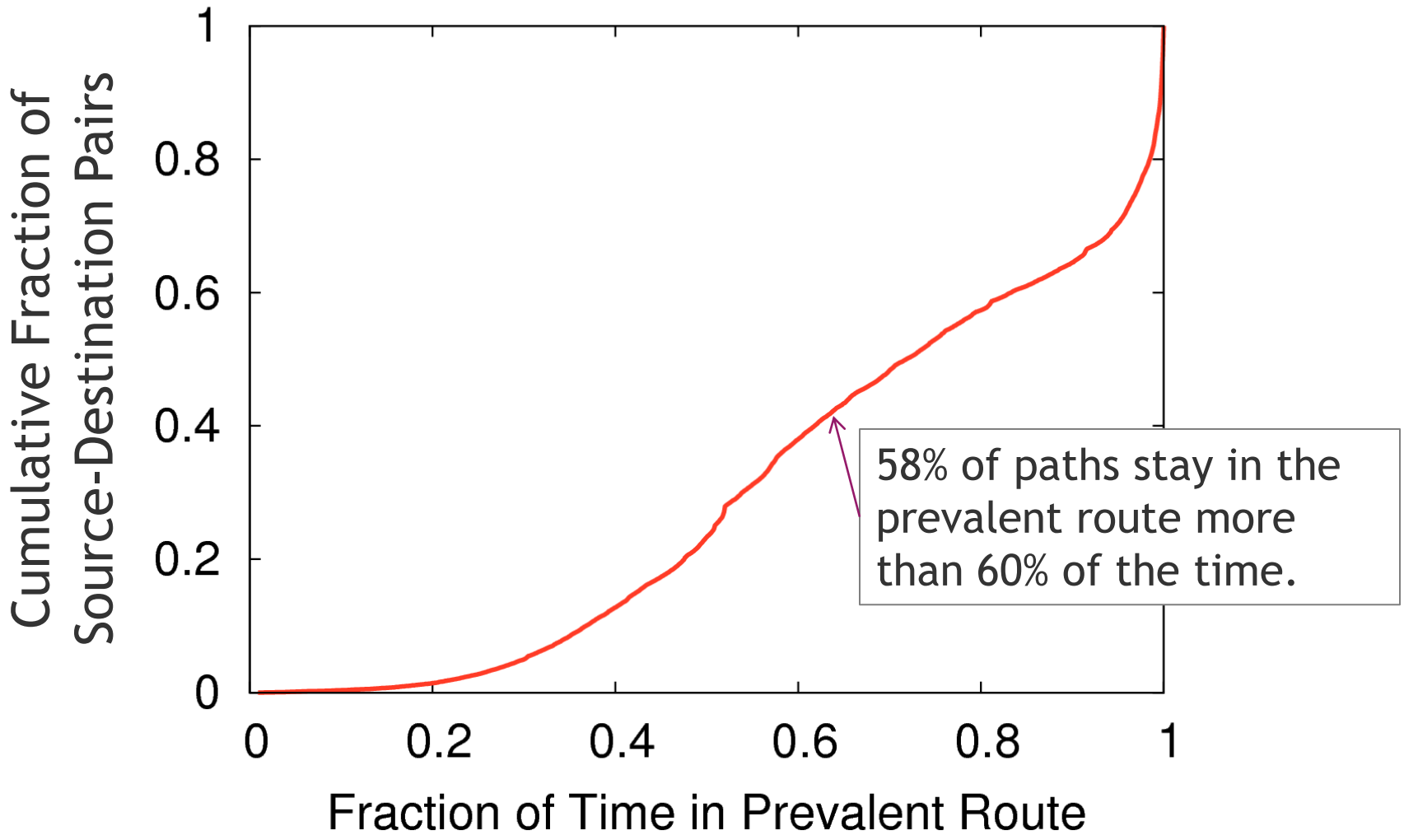
Source-destination pairs have a prevalent route



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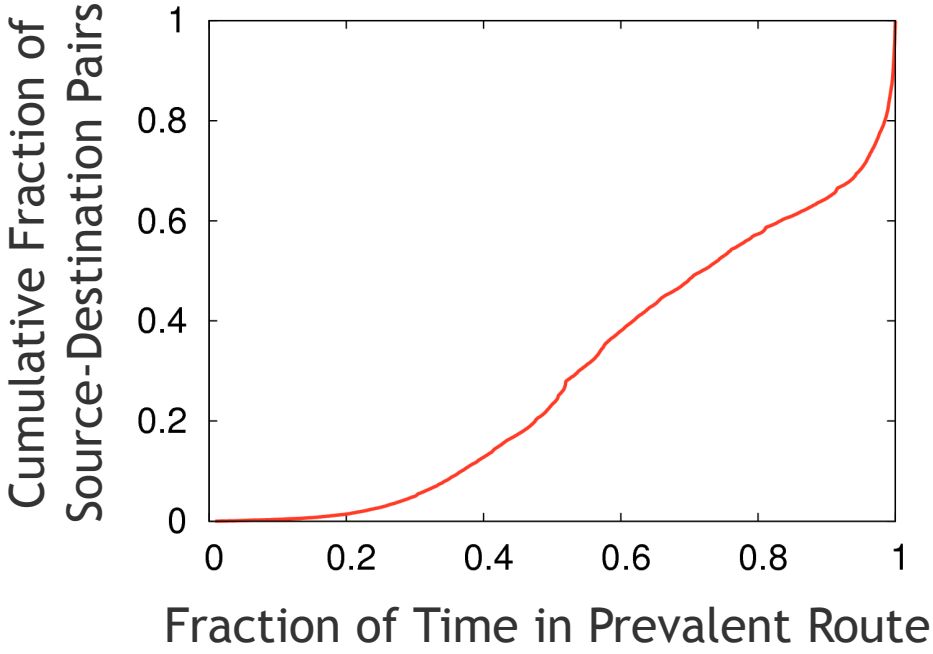
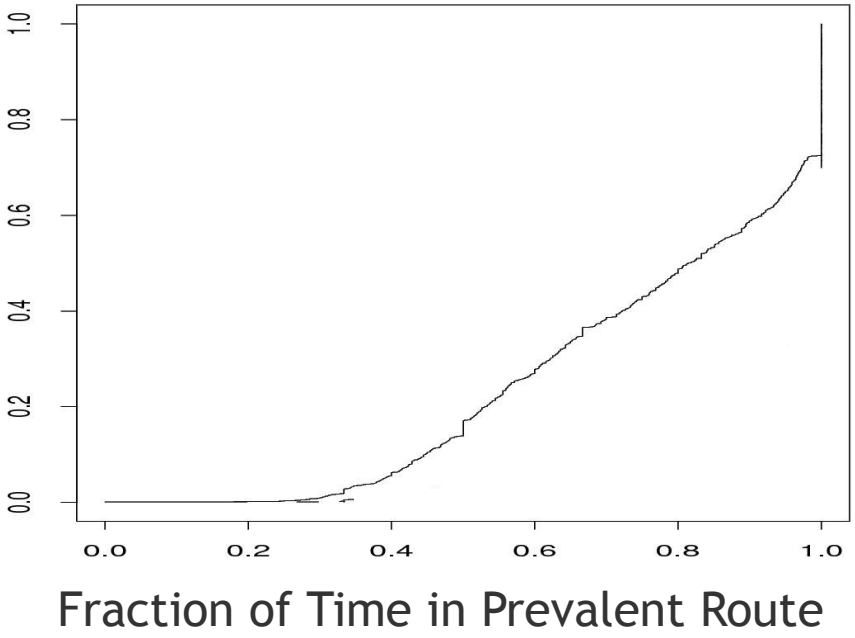
Route prevalence also similar to 13 years ago

Today



Paxson's results '97



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Summary

Measurements of route dynamics cannot ignore load balancing

FastMapping collects complete and frequent route measurements

- Maintains a database of load balancers
- Remaps with Paris traceroute only when there is a change

Internet route dynamics haven't changed much since the late 90's

- Routes are stable most of the time
- Short instability periods
- Source-destination pairs have a prevalent route

Thank you!

Questions?

FastMapping dataset available at:
http://www.thlab.net/~cunha/datasets

Credits

Internet rendering on the first slide by The Opte Project.

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