

In Search for Path Diversity in ISP Networks

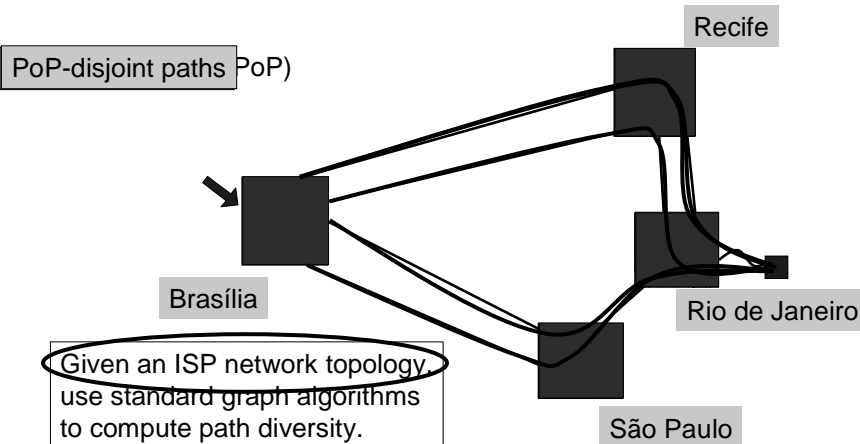
Renata Teixeira, Keith Marzullo,
Stefan Savage, Geoffrey M. Voelker
UC San Diego

*Internet Measurement Conference
2003*

Path Diversity

- ◆ Number of paths for a packet to transit between two points
 - Inside an autonomous system network (ISP)
 - Fully link and PoP (Point of Presence) disjoint paths
 - Observed at IP level
- ◆ Applications
 - Robustness, resilience to failures
 - Traffic engineering
- ◆ How much path diversity is there in real networks?

Path Diversity inside an AS



IMC'2003

3

Topologies Studied

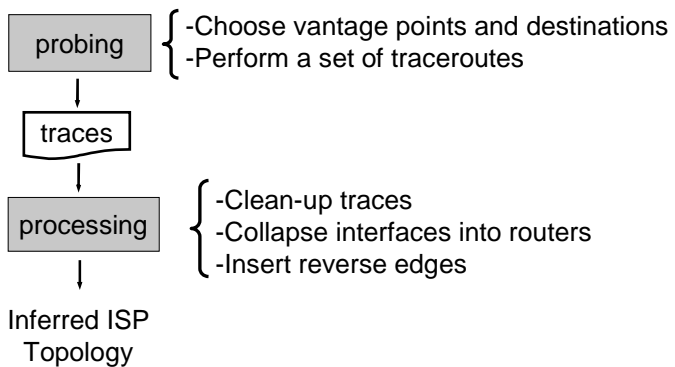
- ◆ Inferred topologies (Rocketfuel)
 - Nine router-level ISP topologies (incl. Sprint)
 - Reconstruct PoP-level topology
- ◆ Exact Sprint network topology
 - PoP-level topology of the continental US backbone network

IMC'2003

4

Inferring ISP Topology

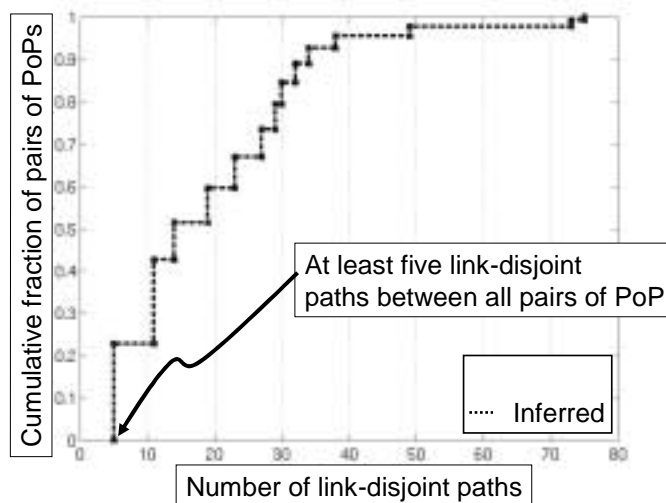
ISP Network



IMC'2003

5

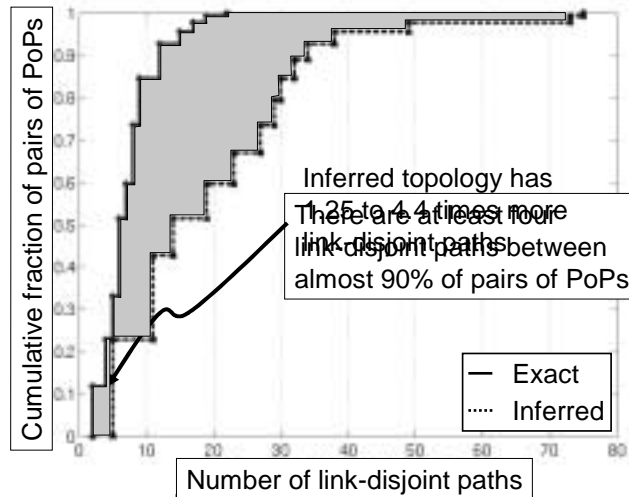
Path Diversity in Inferred Sprint Topology



IMC'2003

6

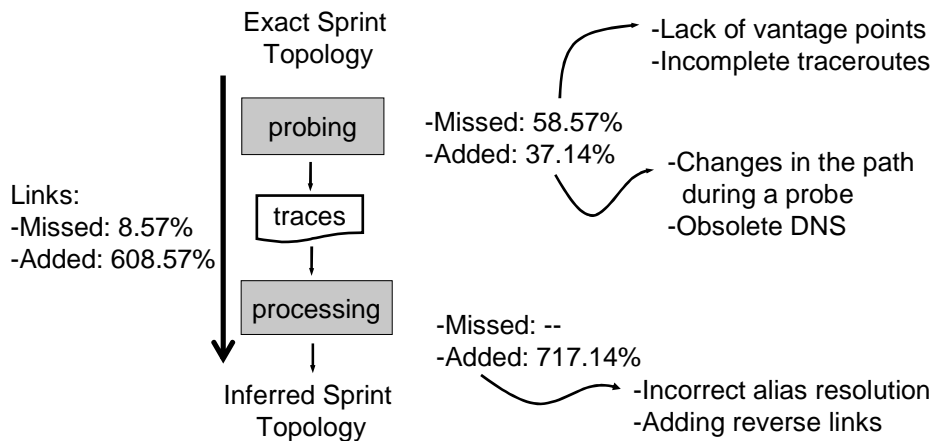
Inferred vs. Exact Path Diversity



IMC'2003

7

Accuracy of Inferred Sprint Topology



IMC'2003

8



Summary

- ◆ Large diversity in path diversity!
 - Depends on network design
- ◆ High level of path diversity in Sprint network
 - 90% of PoP-pairs have at least 4 link-disjoint paths
- ◆ Extracting path diversity is challenging
 - Inferred topologies are not representative of path diversity
 - Getting real data is unrealistic



Warning

Inferred topologies should be used carefully!

- Need to understand limitations of the data
- Impact on relevant topological properties