

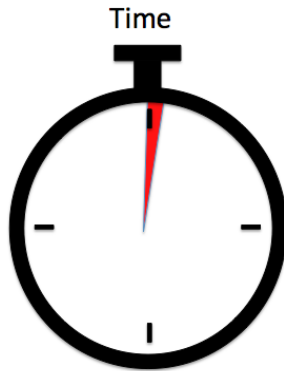
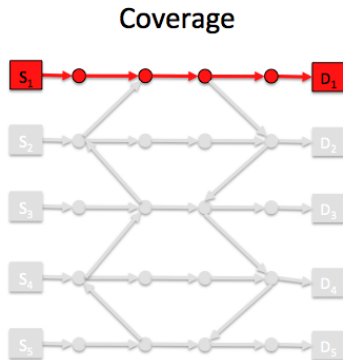
Toward Fast and Efficient IP-level Network Topology Capture

Thomas Bourgeau, Timur Friedman

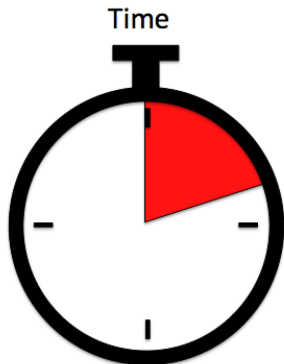
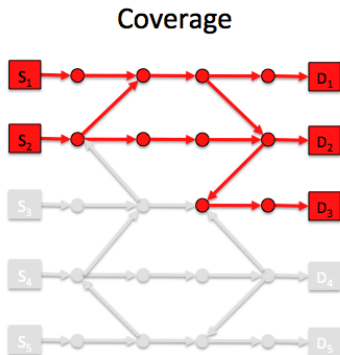
UPMC - SORBONNE Universités

PAM 2013 – March 18th, 2013

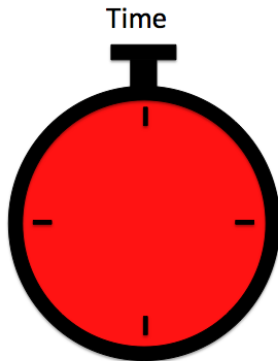
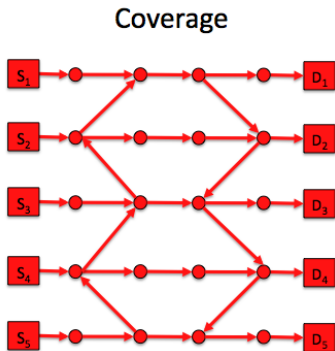




Single traceroute : Take on the order of **seconds**

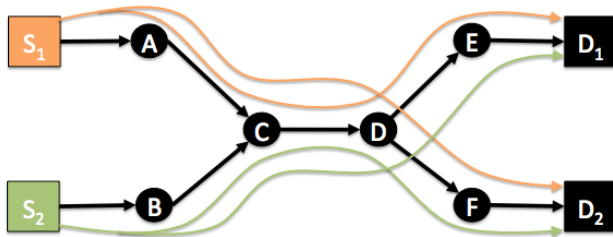


Small scale measurement system : Take on the order of **minutes**



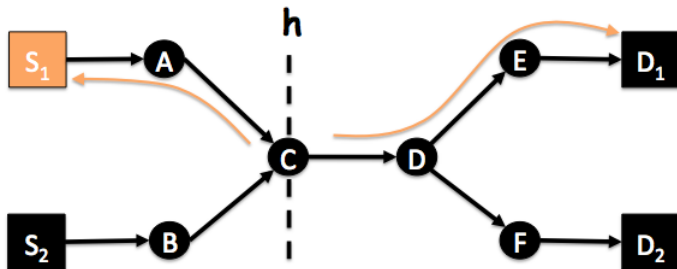
Large scale measurement systems : Take on the order of **days**

Too long to capture dynamics



Standard approach:

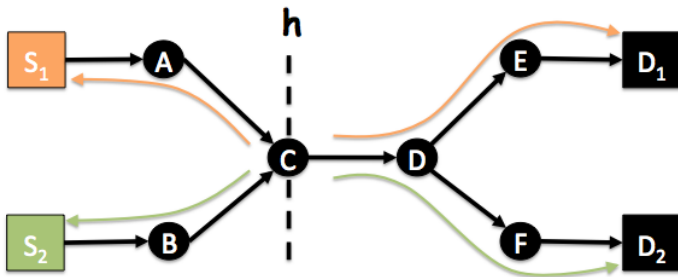
- Uses full traceroutes
- No effort to limit probing redundancy



Doubletree (Donnet et al. 2005):

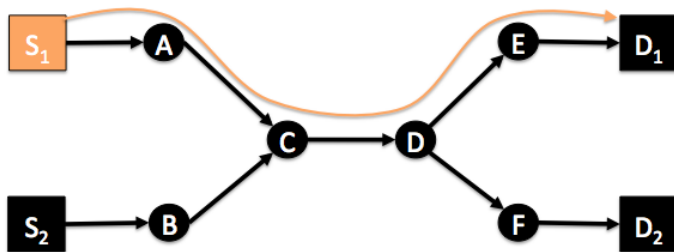
- **Aim:** find all of the source-destination paths
- **Means:** partial traceroutes

Less redundancy: 4 partial paths instead of 8



Doubletree (Donnet et al. 2005):

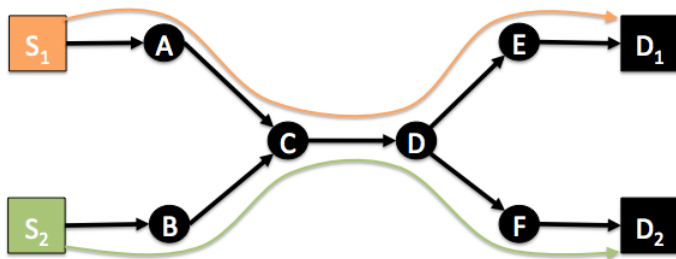
- **Aim:** find all of the source-destination paths
- **Means:** partial traceroutes



Set cover (Shavitt et al. 2009):

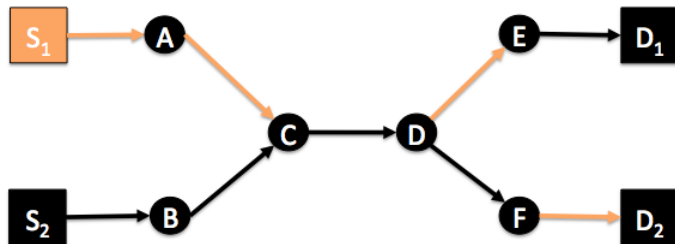
- **Aim:** obtain the entire Graph
- **Means:** fewer full traceroutes

Less redundancy: 2 traceroutes instead of 4



Set cover (Shavitt et al. 2009):

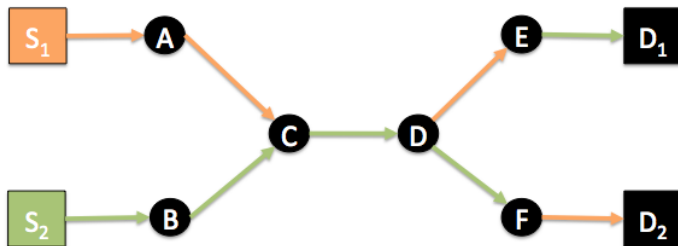
- **Aim:** obtain the entire Graph
- **Means:** fewer full traceroutes



NTC (Network Topology Capture):

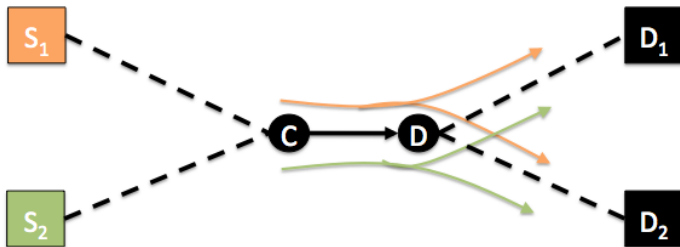
- **Aim:** obtain the entire graph (like set cover)
- **Means:** partial traceroutes (like Doubletree)

Less redundancy: 9 links probes instead of 20



NTC (Network Topology Capture):

- **Aim:** obtain the entire graph (like set cover)
- **Means:** partial traceroutes (like Doubletree)

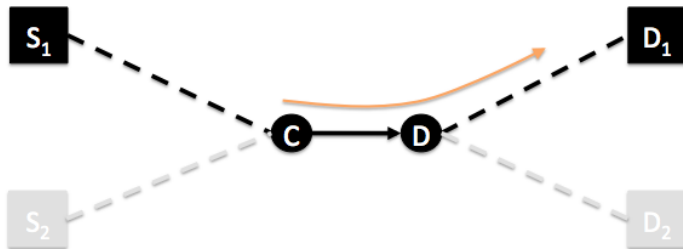


NTC α parameter

Reduce the probing load by selecting randomly α partial traceroutes that see the same link.

If $\alpha = 1$: We keep only one partial traceroute to discover (C, D)

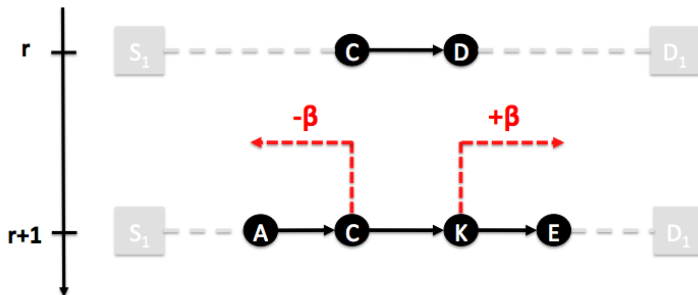
Less redundancy: 2 probes instead of 8



NTC α parameter

Reduce the probing load by selecting randomly α partial traceroutes that see the same link.

If $\alpha = 1$: We keep only one partial traceroute to discover (C, D)



NTC β parameter

When topological change is detected the measurement agent tracks possible dynamism events along the path until β ips are discovered in the backward and forward direction.

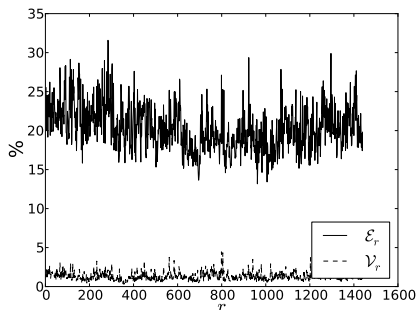


Figure: Fine-grained dynamics

Dataset: Traceroute measurement over PlanetLab Testbed (230 agents, 800 destinations, every 1 hour during 2 months).

Dynamics: $\sim 2\%$ Vertex dynamics and $\sim 20\%$ of Edge dynamics.

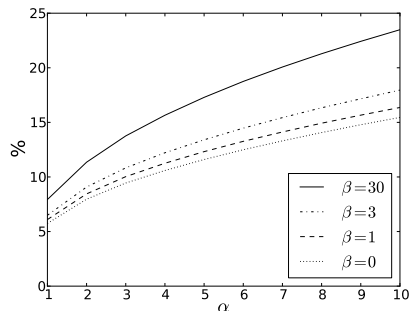


Figure: Load reduction

Load reduction

- Save at most 92% of measurement probes ($\alpha = 1$ and $\beta \leq 30$)
- Accelerate measurement **17 time faster**
- Better load reduction than Doubletree (at most 75% load reduction).

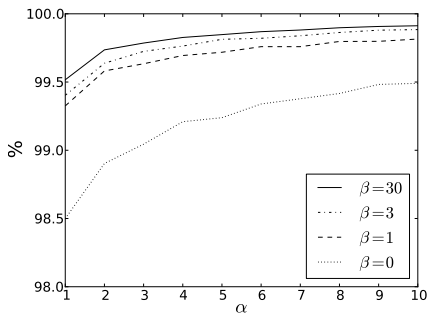


Figure: Vertex coverage

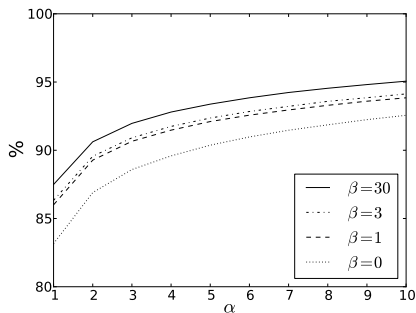


Figure: Edge coverage

Coverage accuracy

- Very high Vertex coverage: [98%, 99%]
- High Edges coverage: [82%, 95%]
- Cover at most 88% of the graph ($\alpha = 1$ and $\beta \leq 30$)

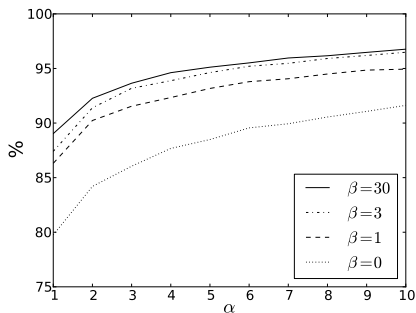


Figure: Vertex dynamics

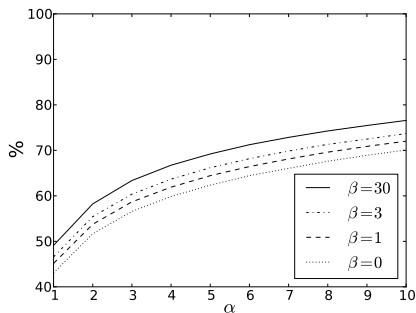


Figure: Edge dynamics

Dynamics captured

- High Vertex dynamics capture
- Low Edge dynamics capture (Mainly due to stars)
- Capture at most 75% of dynamism events with 80% load reduction

Contributions : NTC algorithm.

- ① Sampling with partial traceroutes.
- ② Massive probing load reduction.
- ③ Measurement time acceleration.
- ④ Adaptive probing to better capture dynamics.

Futur work : Enhance NTC algorithm.

- ① Deploy NTC in large scale scenario.
- ② Increase dynamics capture by filtering stars.
- ③ Estimate all paths with the reduction load achieve by NTC.

Thank you

