Applications for Measurement: Improving Anonymity Online

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Anonymity on the Internet

Tor Network
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Tor Network

Does not know the source

Does not know the destination
Online Anonymity via Tor

Tor Client

entry relay

middle relay

exit relay

Server
Threat Model: Network Based Attacks
Threat Model: Network Based Attacks

Tor Network
Threat Model: Network Based Attacks
Internet routing and timing attacks
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Path asymmetry => **Increases the attack surface** [RAPTOR, USENIX 2015]
TCP ACK numbers leak timing and size info on reverse path!
Astoria [NDSS2016] + Cipollino*

- What if the Tor client could pick relays to avoid timing attacks?
- We show that there usually is a safe option [NDSS2016]
- **Challenge:**
  - How can the Tor client learn network paths?
- Astoria: Policy-based simulations on empirically derived AS graphs
- Cipollino: Based on measured paths

Tor client measurement-plane requirements

- Data needs to be current
  - E.g., if a path changes to go through a new AS we need to know!
- Path computations need to be local
  - The client can’t ask a third party about paths to the destination!
- Data needs to be compact + accurate
- Trade-off between:
  - measured data as relevant as possible (near real-time).
  - Cipollino Tor client low-latency (not on-demand measurements)
Our solution: PathCache

- **Basic idea:** Reuse measurements already being made!
- Combine publicly accessible traceroute measurements to learn new paths
  - Currently using RIPE Atlas + iPlane data
  - Augmenting with control-plane data RIPE NCC, Routeviews
  - **Longer term:** Efficient use of new measurements to increase coverage
- [http://pathcache.cs.stonybrook.edu](http://pathcache.cs.stonybrook.edu)
Why is PathCache Useful?

- Everyone needs traceroutes!
- But why run redundant traceroutes at the expense of a constrained measurement budget?
- Measurement hardware can be more effectively utilised.
- Standard and compact graphs as JSONs, easy to work with.
- Try it out here: http://pathcache.cs.stonybrook.edu/api/v1/174 (AS174’s dest based graph)
Future Work?

- Need more data
  - Huge benefit of periodic measurements from RIPE Atlas!
- Path prediction as a service
- A platform to maintain AS-level paths over time (benefit of retrospective measurements)
- Provide a generic interface to upload user-run measurements.
- As a community, increase our coverage via measurement reuse