A Path Transparency Observatory: Initial Design Notes

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measurement and architecture for a middleboxed internet

measurement | architecture | experimentation

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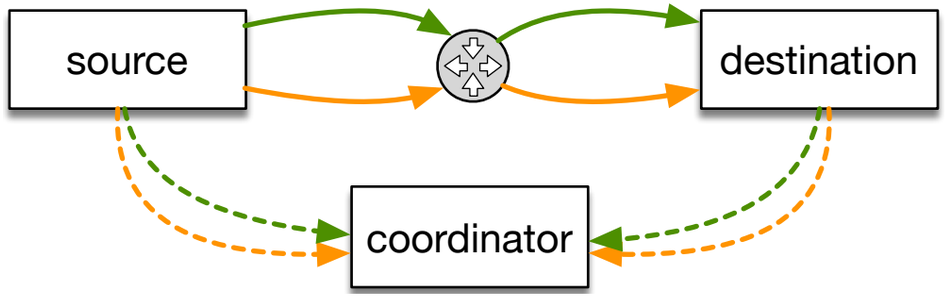
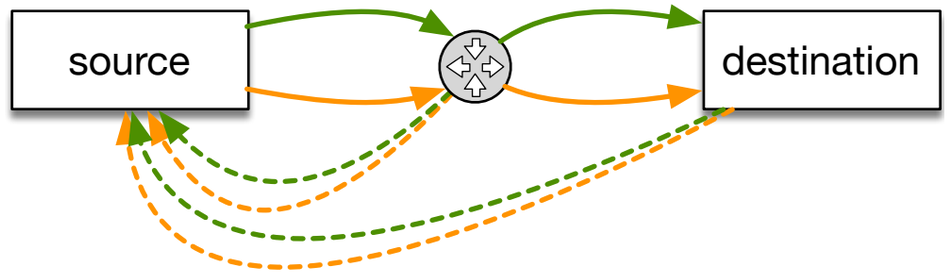
Path Transparency

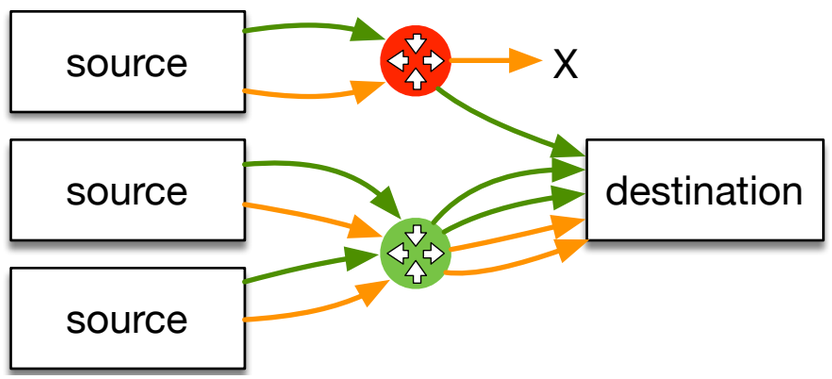
- **Path transparency**: the likelihood a packet stream that arrives at the end of the path is the one that was sent with certain properties.
- **Impairment**: something that keeps a path from being transparent for a certain kind of traffic, dependent on that traffic's properties.
  - Blocked connections, 100% packet loss
  - Increased drop rate, increased latency
  - "Bleaching": removal or rewrite of necessary headers
  - B2B proxying: replacing one e2e path with two

Active Measurement of Path Transparency

- Basic methodology: throw a bunch of packets with certain properties at the Internet, and see what happens.
  - Ideal: two-ended A/B testing
  - More scalable: one-ended A/B testing
  - Comparison with topology to isolate on-path vs near-endpoint impairments
- Observations from platform- and application-level logs of failed attempts to use protocol features also useful.
- Integrate heterogeneous observations from many campaigns for better insight.
  - Build an observatory for this integration







Observatory Requirements

- Accept data from a wide variety of sources, e.g.:
  - Raw output from tools we maintain.
  - Raw packet traces of active measurements.
  - “Here’s data from a measurement study, and references to commits in GitHub for the tools and configuration used to generate it.”
  - “Option foo breaks on these paths but not these paths; we’re not going to tell you where they are, but this set of them belong to a major mobile carrier.”
- Support path pseudonymization and aggregation for privacy.
- Support condition definition with enough precision to allow active measurements to reproduce observations on other paths.
- Integrate with existing tools, without restrictions on implementation.

Observation Data Model Proposal

- An observatory is a collection of single ***observations*** {***t, P, c***} where
  - ***t:*** time at which the observation was taken (and assumed valid)
  - ***P:*** designator of the path on which the observation was taken
    - sequence of node/network/multi-network identifiers or pseudonyms
  - ***c:*** variable-definition expression of the condition observed on that path
    - Ideal: generic language with primitives for common packet structures, without regex performance/expressivity issues.
    - Initial: reference to external condition identifier linked to how it was generated (stable code, configuration, and (when relevant) raw-data reference)
- "Raw" data within the observatory used to back these observations.
- Queries always operate on this intermediate observation representation.