Path Transparency Measurement Summer School

Brian Trammell, ETH Zürich

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measurement and architecture for a middleboxed internet

measurement | architecture | experimentation

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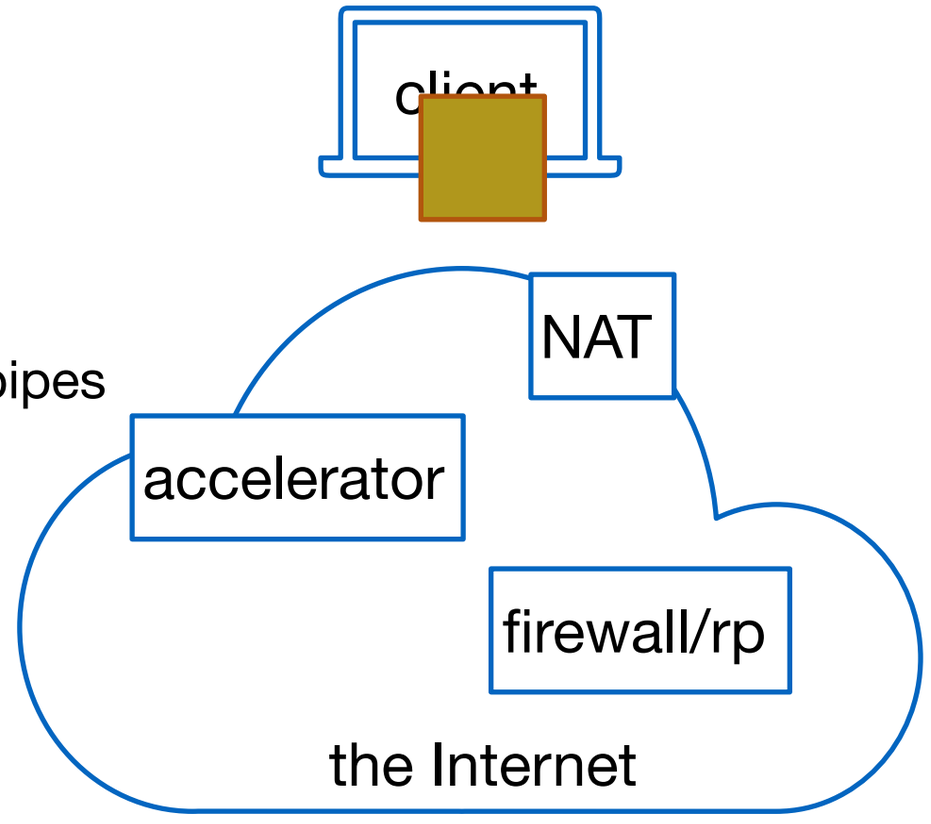
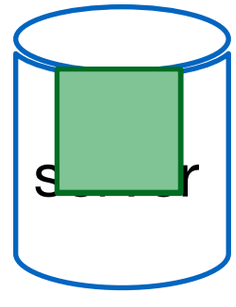
What is this all about?

- The Internet is notionally *transparent:*
  - packets come out the other end of the pipe unchanged.
  - based on the *end-to-end principle*: a maximally capable network made of smart endpoints connected by dumb pipes



- This is not how things actually are, especially at layer 4:
  - Network address translation
  - Extension and option blocking and stripping
  - TCP ACK/SEQ rewriting
  - etc, etc, etc, etc...



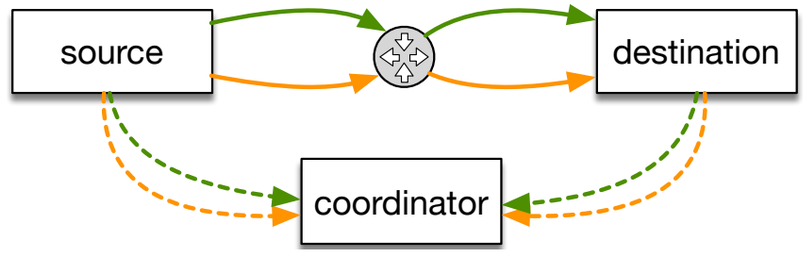
- Designing protocols and protocol extensions that can deal with interference require us to understand the nature and prevalence of different kinds of interference

Internet Measurement: Active versus Passive

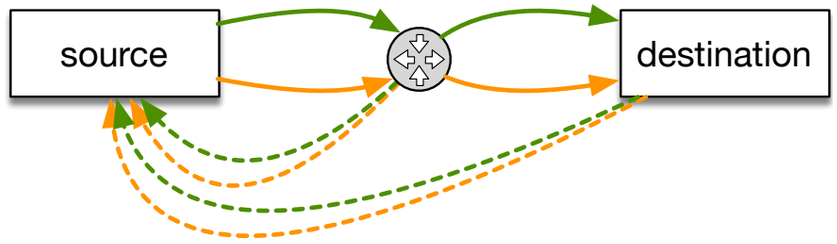
- **Active measurement** uses *dedicated measurement traffic* to induce a measurable reaction from the network and/or far endpoint.
  - Examples: `ping, traceroute`
  - Tradeoffs: you can measure what you're aiming at, but (1) you might not be measuring exactly what productive traffic sees and (2) you have to pay the overhead of unproductive measurement traffic.
- **Passive measurement** observes *productive* traffic and draws inferences about the state of the network and endpoints from what it can see.
  - Example: `wireshark`
  - Tradeoffs: what you observe is what you get, but you can only choose paths opportunistically, and you have to be *very* careful not to over-observe (end-user privacy).
- We focus on active measurement: more suited to path transparency.

Active Measurement of Path Transparency

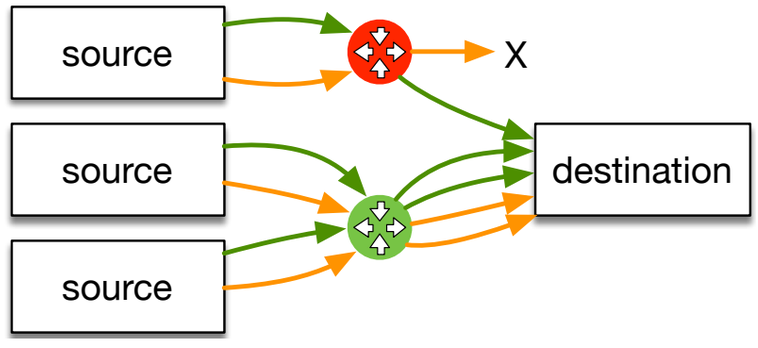
- To find out what the path breaks, throw packets at it and see what happens.
- Controlled experimentation: compare "vanilla" traffic to some feature under test.
  - Ideally, we control both endpoints, and can compare packets we send to packets received.



- When this scales poorly, we can infer path behavior from the destination's response, or induce routers to send us a response.



- Comparing results from multiple vantage points with different paths toward the same destination allows us to infer on-path (versus on-endpoint or near-endpoint) interference.



Tradeoffs in Selecting Vantage Points

- Mesh of testbed nodes (e.g. Planetlab): full control of both endpoints, but networks tend to be non-representative.
- Core endpoints (e.g. DigitalOcean, AWS) toward public targets (e.g. Alexa TopN): requires inference based on induced behavior; scales nicely but misses access network impairments.
- Residential testbeds toward public targets: Covers access network impairments, but difficult to build out and/or arrange access, high-bandwidth tests impractical.
- Mobile testbeds (e.g. MONROE): Covers mobile access networks, but high-volume and high-bandwidth tests impractical.

Today's agenda:
two measurement tools and one data collector

- Tracebox: extends traceroute functionality to localize modifications to headers on paths.
  - Korian Edeline, x:00 - x:00
- PATHspider: active measurement tool to measure effects of attempting to use various protocols/extensions
  - Iain Learmonth, x:00 - x:00
- PTO (Path Transparency Observatory): combines and analyzes path transparency information from multiple sources for repeatable, comparable measurements
  - Brian Trammell, x:00 - x:00

Preparation

- Tracebox VM
  - install git, vagrant, virtualbox
  - `$ git clone https://github.com/mami-project/vpp-mb -b demo`
  - `$ cd vagrant && vagrant up`

- PATHspider / PTO VM
  - install virtualbox, configure bridged networking
  - download `http://summerschool.mami-project.eu/pathspider.ova`