# Internet Path Transparency Measurements using RIPE Atlas

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measurement and architecture for a middleboxed internet

#### measurement

architecture

### experimentation



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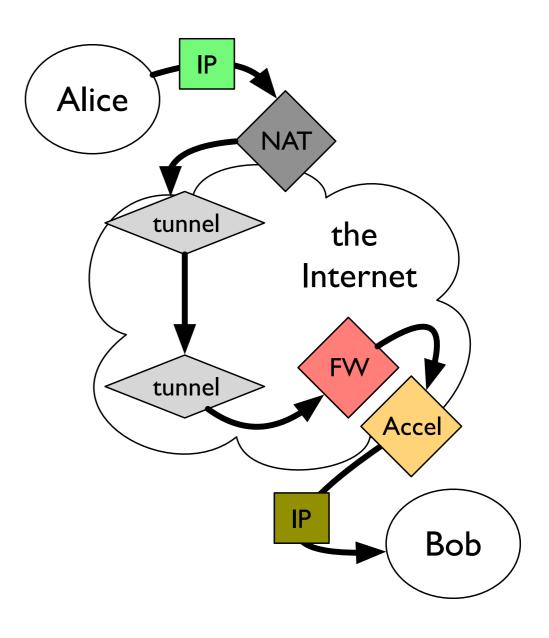


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# path transparency (in one slide) (From MAT at RIPE 71)



- The Internet is not end-to-end...
  - some of this is policy, but a lot of it is accident
  - deployment of new protocols over IP, transport extensions difficult or impossible
- ...but some paths are worse than others.
  - Goal: data on "how bad" and "where" to guide future protocol design
  - In operations: another tool for troubleshooting connectivity dependency for unusual traffic

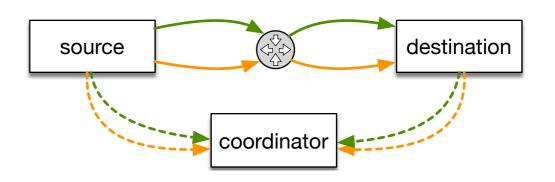


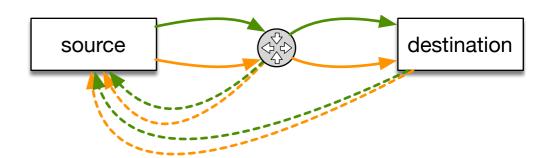


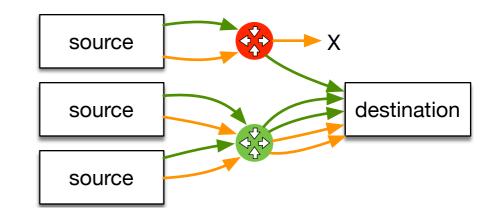
# **Background: Active Measurement of Path Transparency**



- Basic methodology:
  - 1. throw a bunch of packets at the Internet
  - 2. see what happens.
- Ideal: two-ended A/B testing
- Scalable: one-ended A/B testing
- Multiple sources: isolate onpath from near-target impairment









#### "Can we run the Internet over UDP?"



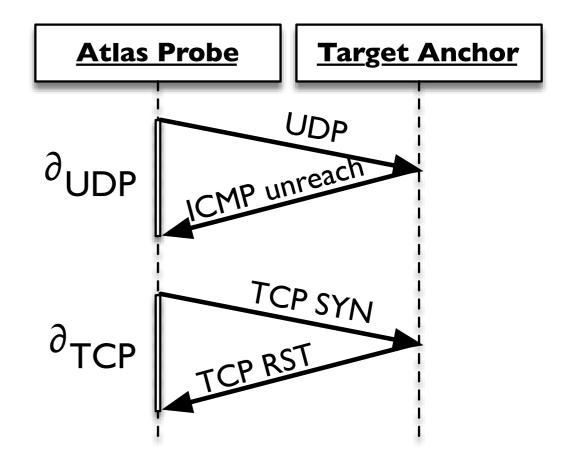
- UDP encapsulation attractive for new transport protocols
  - (mostly) NAT- and middlebox-compatible header
  - wide availability of APIs in userland
- Lots of current work:
  - WebRTC data channel: SCTP/DTLS/UDP
  - QUIC: new HTTP/2 new transport over UDP
  - SPUD: universal shim for explicit cooperation
- Is this safe?
  - Widespread operational practice may hinder UDP



#### RIPE Atlas to the rescue



- No arbitrary TCP/UDP on Atlas…
- ...but: traceroute!
  - basic connectivity and firstpacket latency with high TTL
- Many probes to many anchors
  - How many probes on UDP blocked networks?
  - Is blocking path- or accessnetwork dependent?

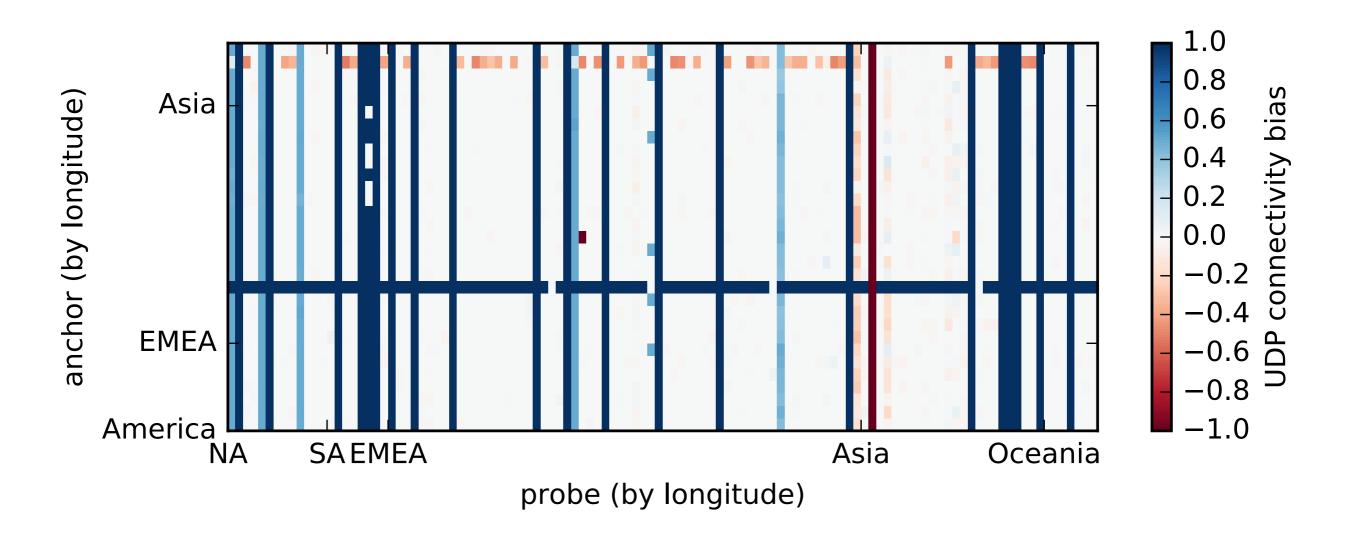






### TCP appears more impaired than UDP



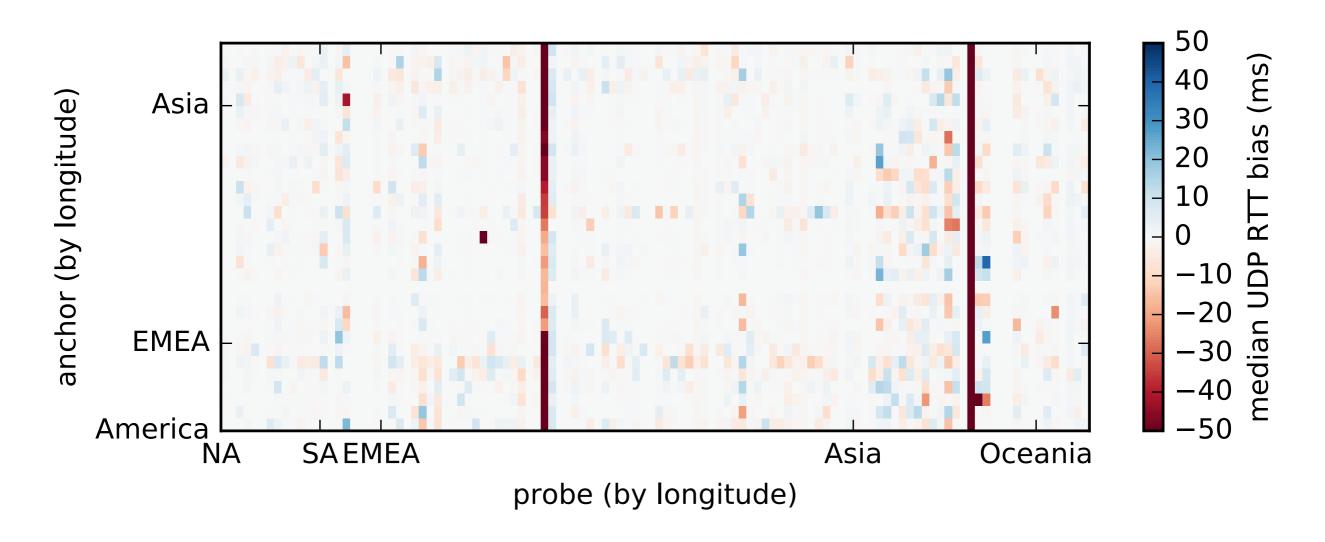


Connectivity, UDP/33435 vs TCP/33435, <= 19 trials, 128 probes to 32 anchors September 2015



# RTT bias mostly probe-dependent



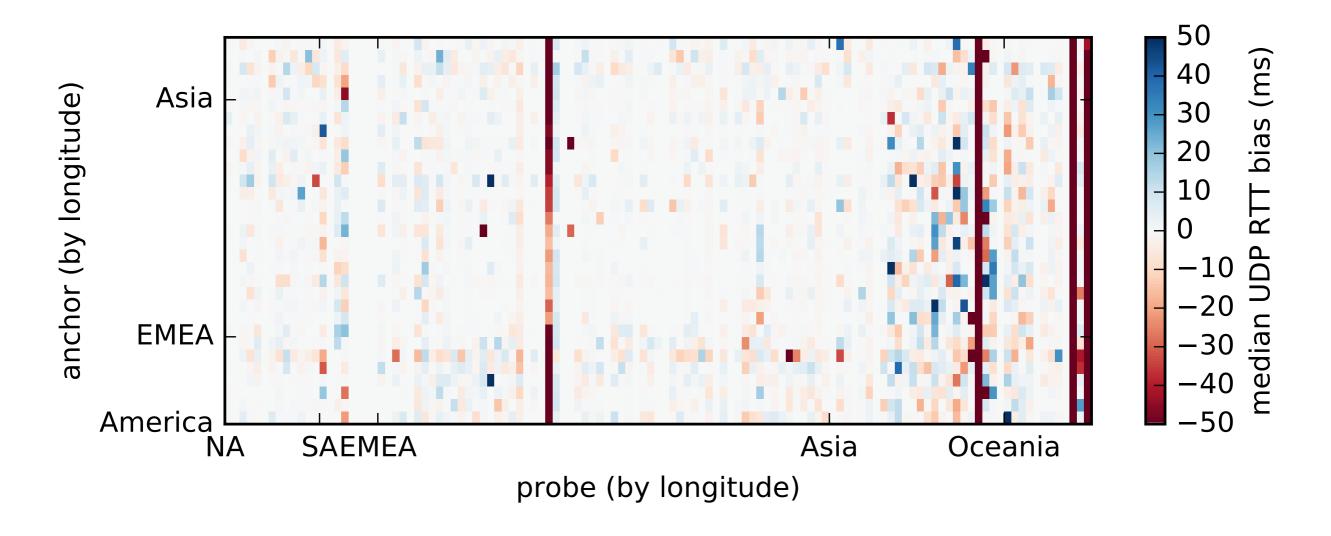


Median RTT bias, UDP/33435 vs TCP/33435, <= 19 trials, 128 probes to 32 anchors September 2015



### More interference with TCP/80





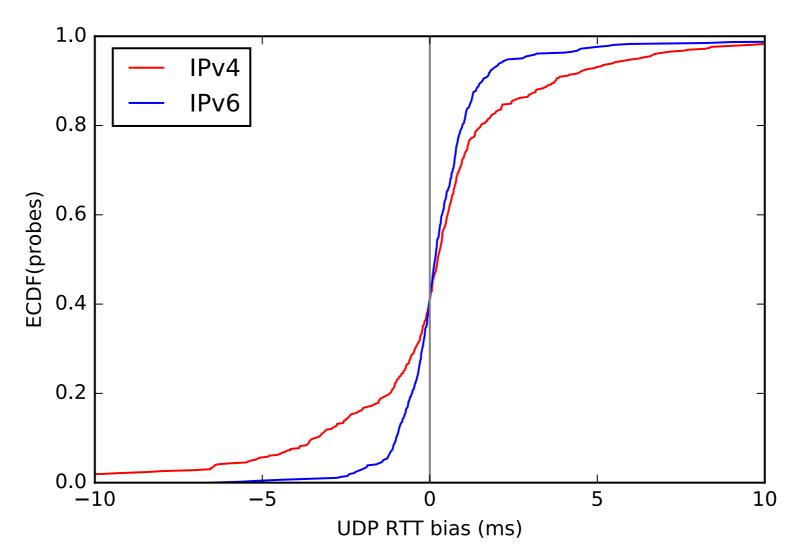
Median RTT bias, UDP/33435 vs TCP/80, <= 19 trials, 128 probes to 32 anchors September 2015





# RTT bias spread tighter on IPv6 than IPv4





Median RTT bias, UDP/33435 vs TCP/33435, 464 probes to APNIC anchor Feburary 2016



# ...not so fast: UDP blocked on one in thirty Atlas probe networks

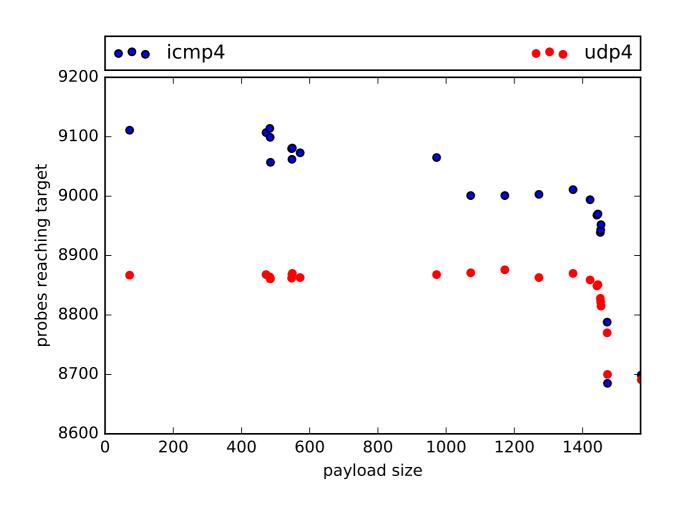


- Methodology: find all probes
  - that tried to do at least 9 UDP traceroutes in 2015.
  - to targets that were up at the time
  - and that showed connectivity via TCP or ICMP
- 2240 probes meet this criterion
  - How many of these never succeeded via UDP?
- 82 probes, largely on networks with marginal connectivity
- Running the Internet over UDP needs a backup for this 3.6%
  - (In line with a 6-7% "QUIC doesn't work" reported in HOPSRG)



## Are larger UDP packets blocked?





- Apparently not
  - one-off measurement, Mar '16,
     9396 probes to one anchor
- No additional blocking after 512, 1024 for IPv4

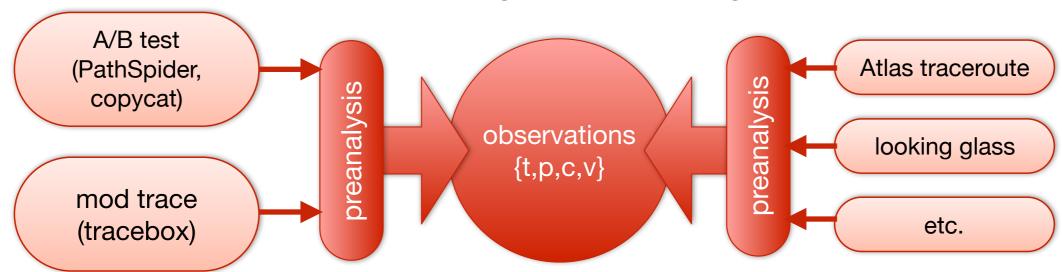
(In this short campaign,
 296 of 9262 probes
 (3.2%) may block UDP)



## A Path Transparency Observatory



- Atlas traceroute gives us a small part of the picture
  - copycat: differential bandwidth/loss test for UDP encapsulation
  - PathSpider: generalized protocol-dependent connectivity testing
- We need to integrate measurements from these different tools
- Observatory (public release end 2016) to derive common
   observations about conditions on a given path at a given time



Watch this space: <a href="https://mami-project.eu">https://mami-project.eu</a>



#### Conclusions



- Atlas useful for estimating UDP/TCP connectivity
  - it's a hack, but it's a nice one
- UDP not as broken as we'd thought
  - still not universal enough to run the Internet over it
- Like all measurement people, we need more data
  - And are building an observatory to aggregate and analyze path transparency info at Internet scale
- Questions? <{trammell, mirja.kuehlewind}@tik.ee.ehz.ch>

