

# WP 1: Measurements

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measurement and architecture for a middleboxed internet

measurement

architecture

experimentation

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# Agenda

- Overview
- Measurement Tools
- Data Storage
- Publications
- Conclusion



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# Overview - Goals

- Large-scale measurements on the dynamics of the packet mangling by middleboxes
- Measurement tools development
- Data
  - storage
  - availability

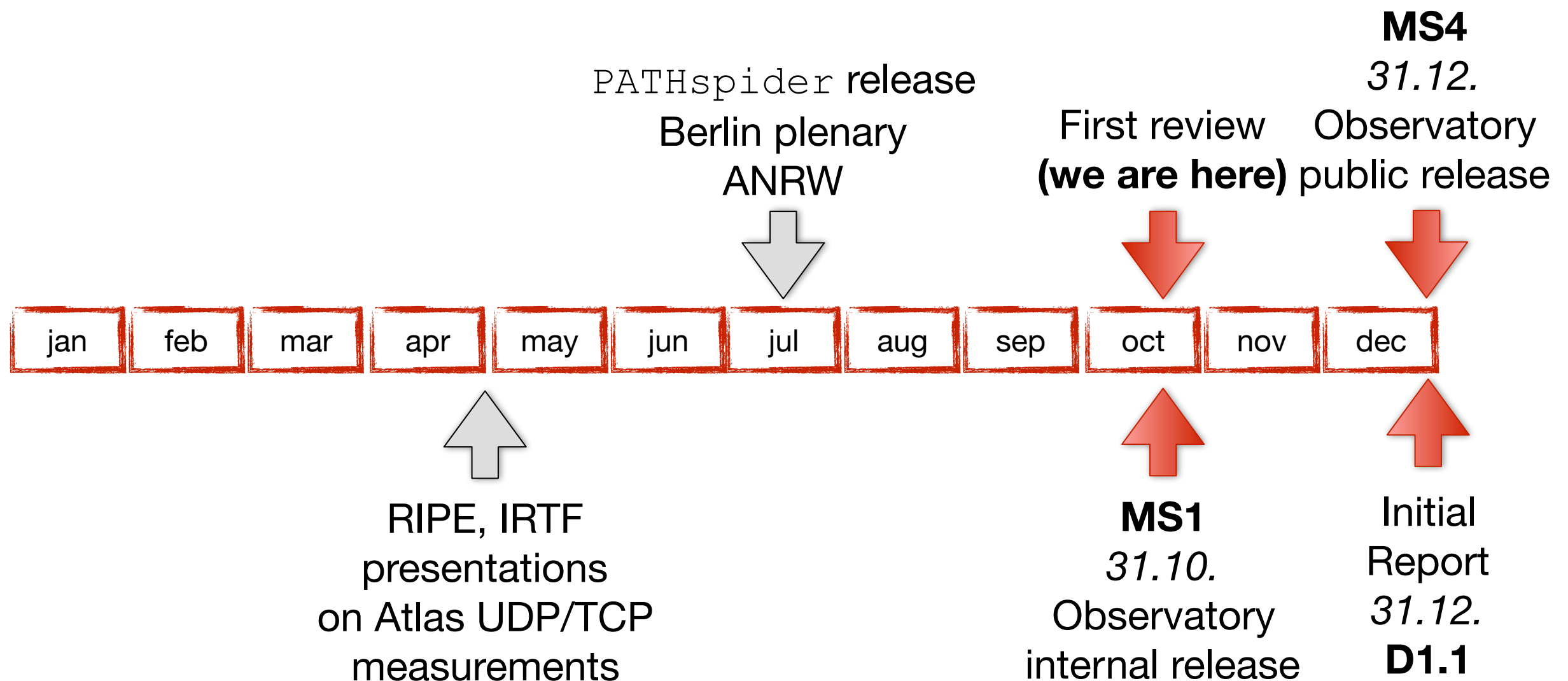


# Overview - What we are doing?

- Methodology and Measurement Tool Design [1.1, in progress]
  - `tracebox`: middlebox detector, integration with `scamper`
  - `PATHSpider`: A/B path impairment testing, new plugins and framework improvements
  - `copycat`: UDP/TCP differential treatment detection
  - NAT Revelio: CGN detection
- Measurements
  - Initial Measurements and Middlebox Detection [1.2, in progress]
    - `atlas`, `copycat/tracebox` on Ark, PathSpider ECN, TFO, DSCP runs.
  - large-scale measurements [1.3, from January 2017]
    - based on experience gained from 1.2
- Data Model and Middlebox Observatory [1.4, in progress]

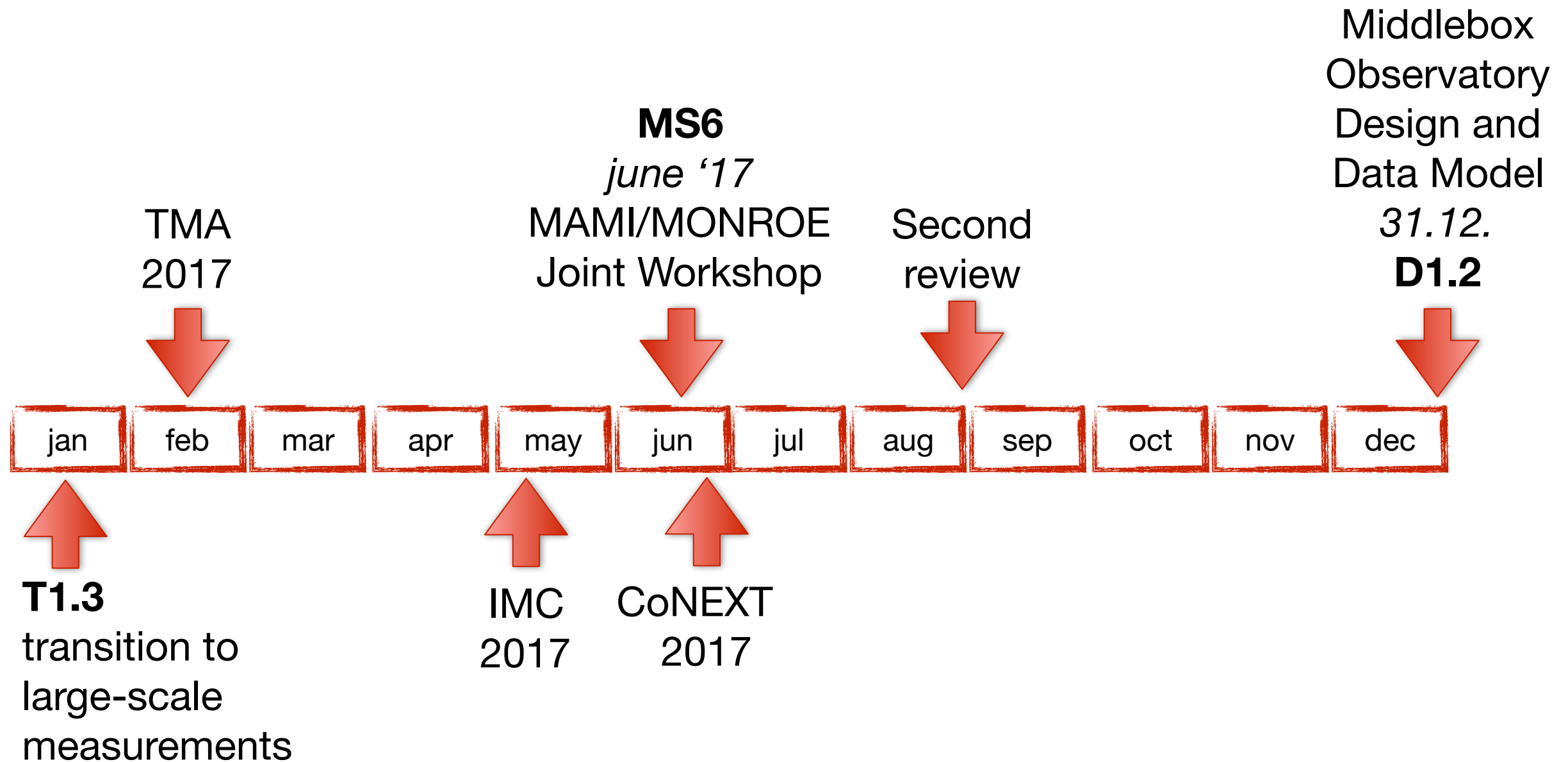


# Overview - Timeline 2016 (Y1)





# Overview - Timeline 2017 (Y2)



# Overview - Who does what?



so far, this has been achieved or is ongoing

Partner	MM	Task 1.1 Methodology and Tools	Task 1.2 Initial Measurement	Task 1.3 Large-Scale Measurement	Task 1.4 Data Model and Observatory
ETH	20	✓ pathspider (+mPlane SDK)	✓	✓ Edit D1.3 (2018)	✓ Edit D1.2 (2017)
ULg	12	✓ tracebox + copycat	✓ Edit D1.1 (Dec)		
UoA	15	✓ pathspider	✓	✓	
ZHAW	8				✓
SRL	6	✓ revelio		✓	

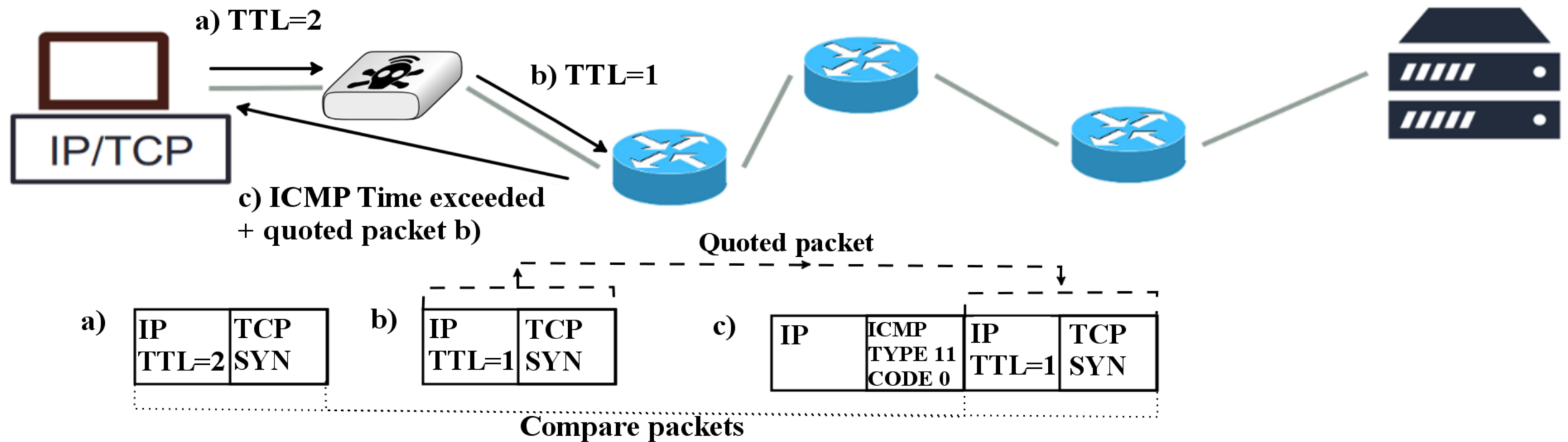




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- **Measurement Tools**
  - `tracebox`
  - `PATHSpider`
  - `copycat`
  - `NAT revelio`
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# tracebox - Concept





# tracebox - Data overview

- Already collected
  - PlanetLab (Top 1M Alexa)
  - March 2016 → July 2016
  - 1/4 of the dataset is already in the Observatory
- Being collected
  - PlanetLab (Top 1M Alexa)
  - Archipelago (IPv6)
- To-be collected
  - RIPE Atlas
- Started collecting data
  - MONROE



# tracebox - Mobile networks

- Data collected with traceboxAndroid
- Dataset
  - 214 users, from 45 countries
    - 80 carriers
    - 252 wifi networks
  - mobile phones
    - cellular: 37 rooted, 70 unrooted
    - wifi: 61 rooted, 211 unrooted
- Will be uploaded asap in the Observatory



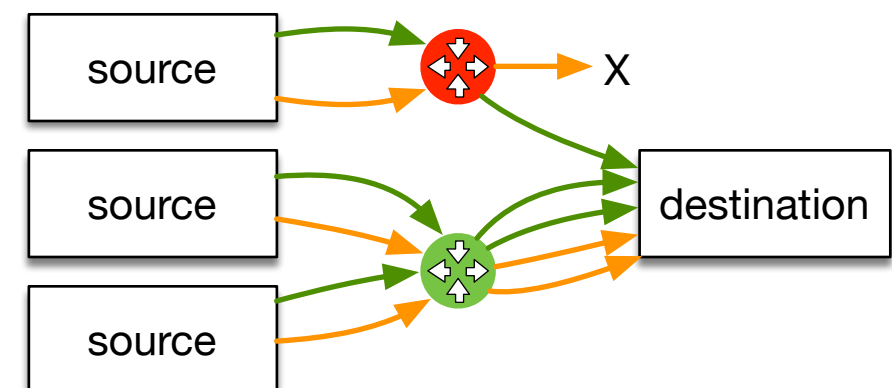
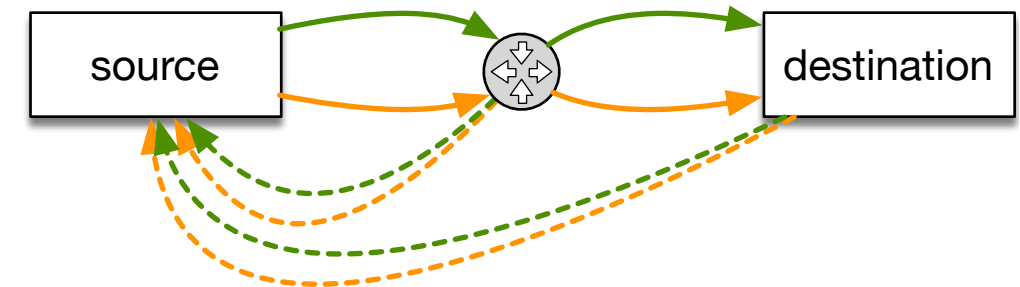
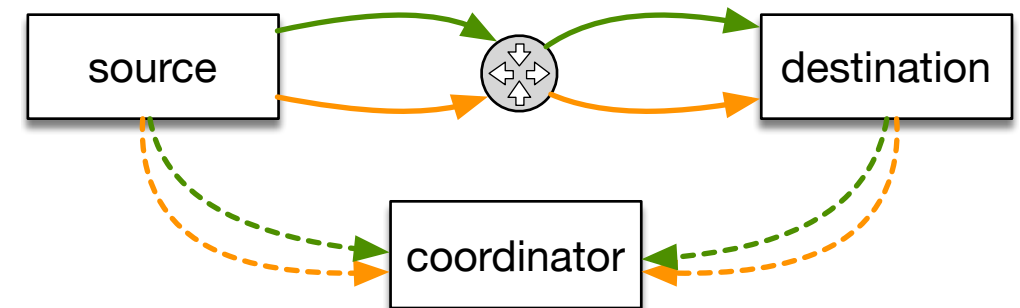
# tracebox - Mobile network algorithms

- Among others
  - Proxies detection
  - NAT detection
  - Options feasibility tests



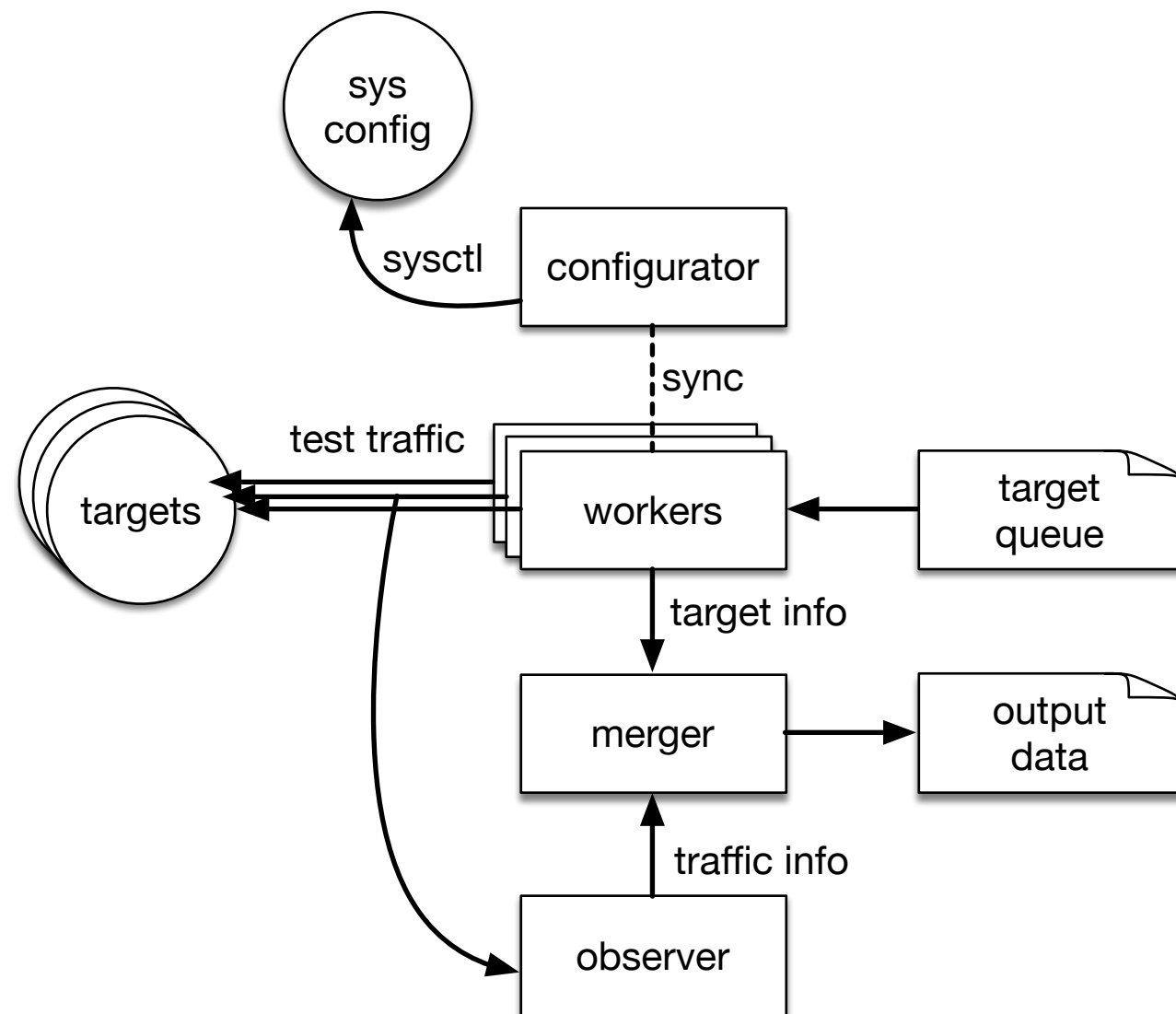
# PATHSpider - Background

- 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 on-path from near-target impairment
- PATHSpider provides a framework for generalizing and scaling the one-ended approach.
- Details: see <https://pathspider.net>





# PATHSpider - Architecture



- *Configurator*: puts system into configuration A or B (e.g., `sysctl`)
- *Workers*: generate test traffic
- *Observer*: passively observes test traffic
- *Merger*: combine information about active measurement with passive observations.
- Plugins allow for customizing traffic generation and observation for each kind of test (ECN, DSCP, TFO, etc.)
- Output fed into Path Transparency Observatory



# PATHSpider - Data overview

- Explicit Congestion Notification (ECN) to Alexa top 1M websites:

	IPv4	IPv6	all
No ECN connectivity issues	<b>99.5%</b>	<b>99.9%</b>	<b>99.5%</b>
ECN successfully negotiated	<b>70.0%</b>	<b>82.8%</b>	<b>70.5%</b>

- Cited in June '16 Apple announcement to activate ECN by default.
- Differentiated Services Codepoint (DSCP): ~10% of Alexa top 100k have unexpected DSCP values on downstream. Non-zero DSCP causes connection failure on up to 0.07% of paths.
- TCP Fast Open (TFO): 0.1 % of Alexa top 1M supports TFO (mostly Google). CPE, anti-DDoS sites impair TFO.
- More detailed DSCP and TFO measurements under submission to PAM '17
- Data being currently collected on MONROE



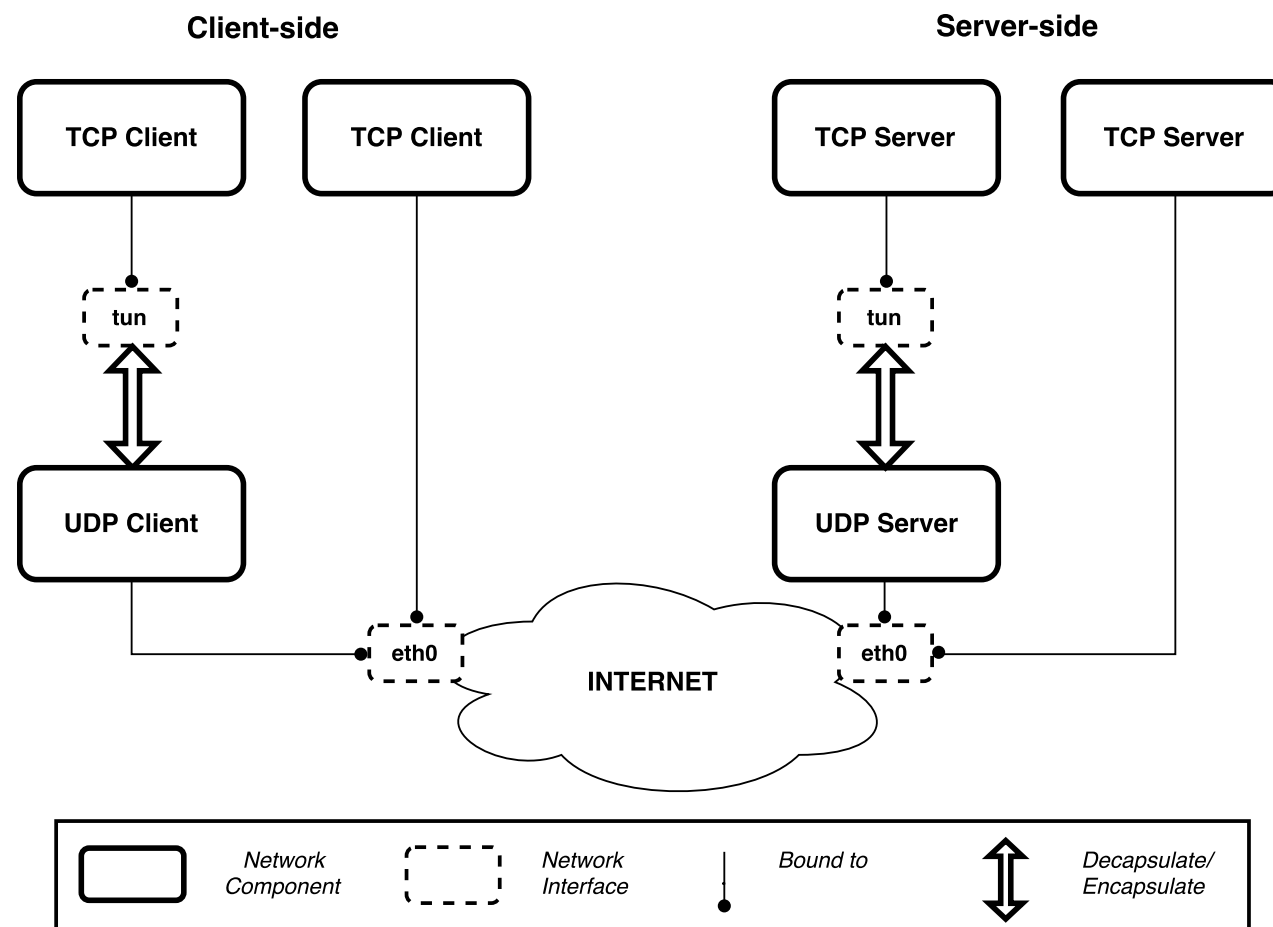


## copycat - Basics

- UDP encapsulation to circumvent middleboxes impairments (SCTP, QUIC, SPUD)
- Does the path discriminate flows based on transport?
- Study with `copycat`
  - differential treatment
    - connectivity, QoS, ...
  - is transport protocol *X* less ossified than *Y*?
    - e.g., TCP vs. UDP
- Details at <https://github.com/mami-project/udptun>



# copycat - Architecture



- runs pairs of flows between 2 end-points
  - one TCP flow
  - one TCP flow user UDP as outer transport
- same 4-tuple between both flows
- copycat uses a tun virtual network interface for encapsulating TCP within UDP
- both ends are under control



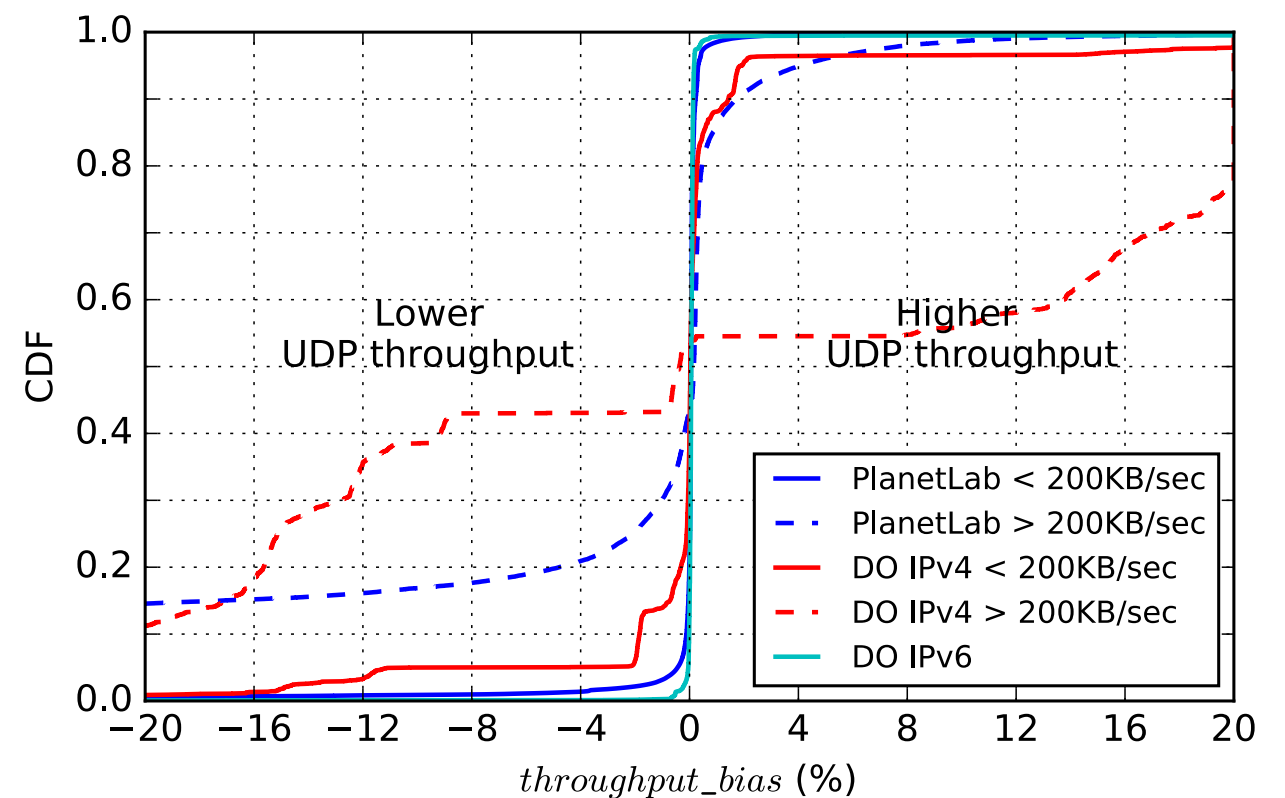
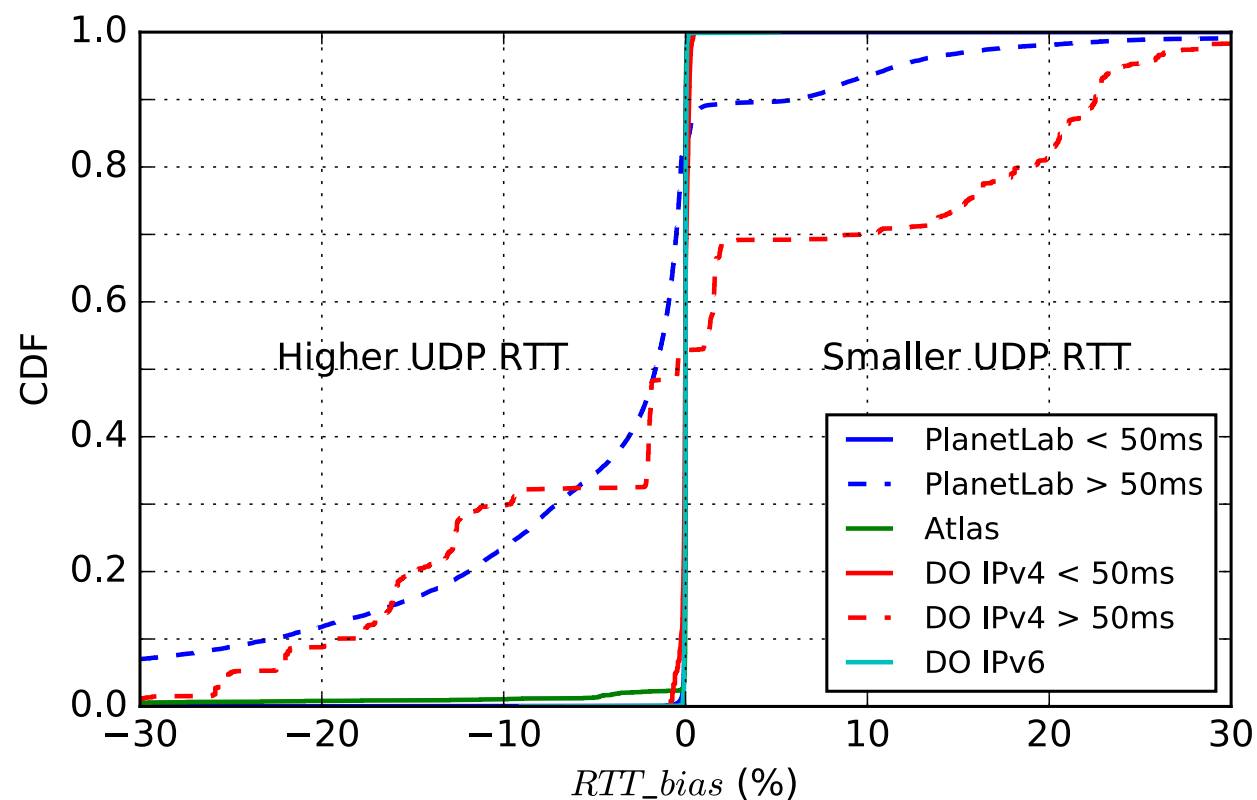
# copycat - Dataset

- PlanetLab
  - full mesh measurements between 93 PL machines
  - March 6<sup>th</sup>, 2016 → April 23<sup>rd</sup>, 2016
  - already in the Observatory
- DigitalOcean
  - full mesh measurements between 6 DO machines
  - May 2<sup>nd</sup>, 2016 → May, 12<sup>th</sup>, 2016
  - IPv4 and IPv6
  - already in the Observatory
- + RIPE Atlas pings

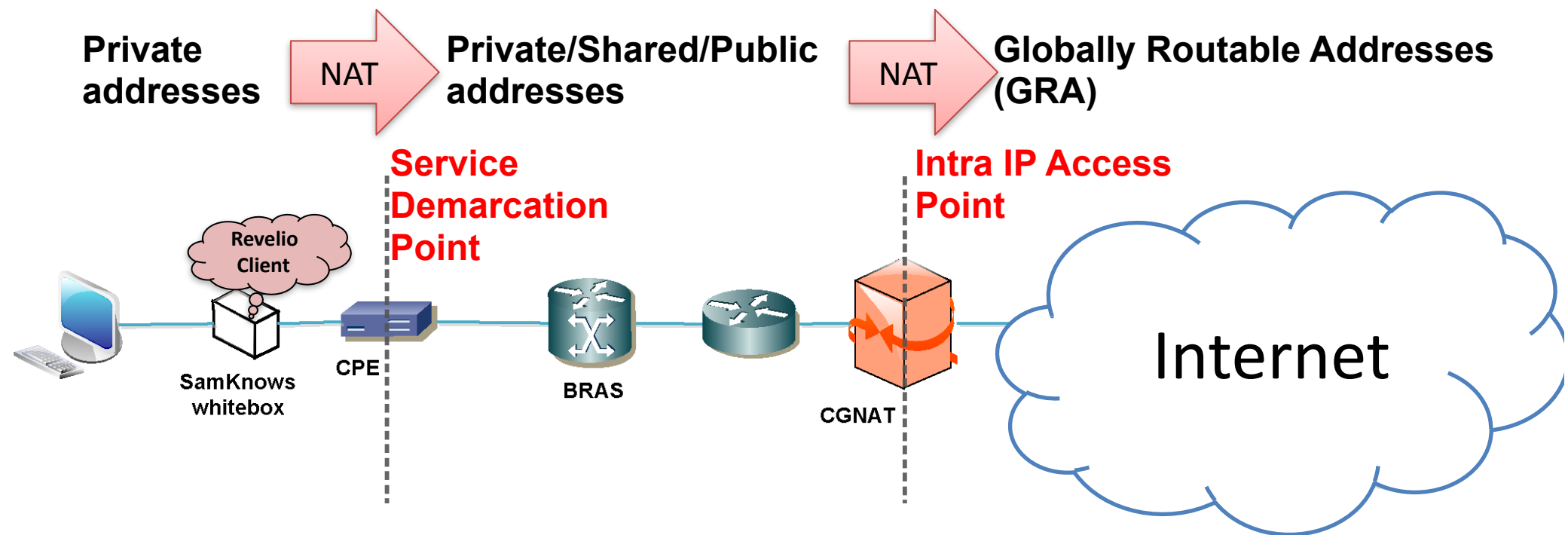


# copycat - UDP vs. TCP results

- UDP connectivity bias: -1% to -5% depending on ports



# NAT Revelio - Basics



- Detect the usage of *private/shared address space* beyond the service Demarcation device (CPE), in the ISP access network
- Detection the location (*home network or ISP access network*) device doing the translation to the GRA of the subscriber



# NAT Revelio - Phases

- The NAT revelio test suite includes 2 phases

## *1. environmental characterization*

- understand the environment hosting the device running the Revelio client
- objective: avoid NAT444 false positives

## *2. NAT444 discovery*

- detection of signals that the ISP might deploy a NAT444 solution in the ISP access network
- objective: access link detection



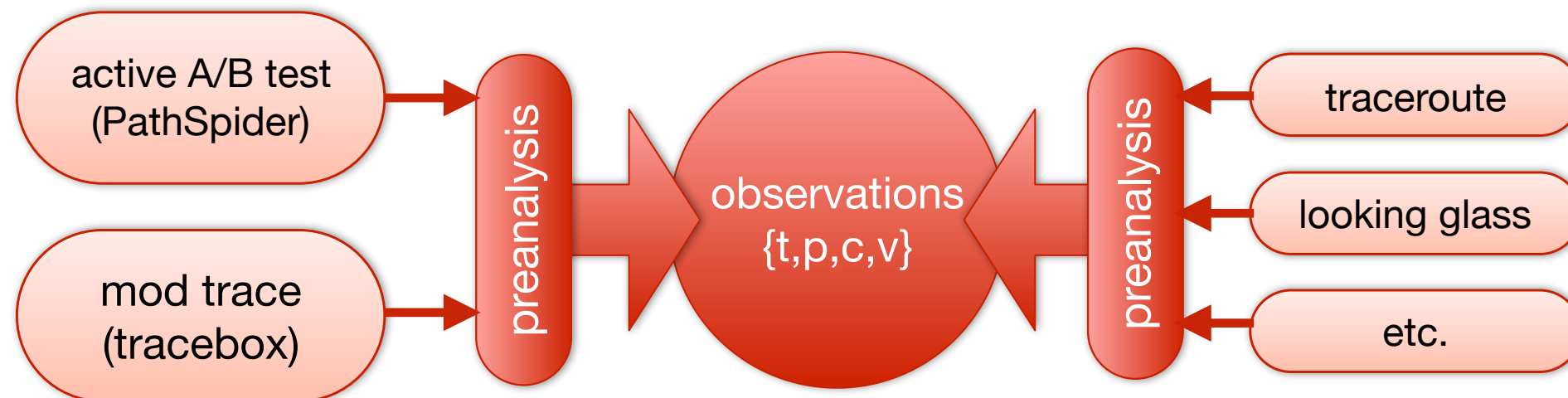
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# Path Transparency Observatory (PTO)

- Make decisions about deployability with data
  - Active measurements made by the project
  - External measurements (e.g. traceroutes, BGP, traces)
- Focus on easing replication and providing insight to Internet operations community and general public



- More details, front-end demo this afternoon





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## Publications - Papers

- S. Neuhaus, K. Edeline, B. Donnet, E. Gubser. *Towards an Observatory for Network Transparency Research*. In Proc. Applied Network Research Workshop (ANRW). July 2016
- I. Learmonth, B. Trammell, M. Kühlewind, G. Fairhurst. *PATHspider: A Tool for Active Measurement of Path Transparency*. In Proc. Applied Network Research Workshop (ANRW). July 2016
- M. Varvello, J. Blackburn, D. Naylor, K. Papagiannaki. *EYEORG: A Platform for Crowdsourcing Web Quality of Experiment Measurements*. In Proc. ACM CoNEXT. December 2016



# Publications - Presentations

- M. Kühlewind. *What if We Designed Measurement as a First-order Service?* RIPE 72 RACI, Copenhagen (Denmark), May 2016.
- B. Trammell. *Internet Path Transparency Measurements using RIPE Atlas*. RIPE 72 MAT WG, Copenhagen (Denmark), May 2016.
- B. Trammell, *Can we run the Internet over UDP?*, IRTF MAPRG, Buenos Aires (Argentina), April 2016.
- B. Trammell, M. Kühlewind. *On Explicit In-Band Measurement*. Cisco - Ecole Polytechnique Network Innovation and Research Symposium, Paris (France). March 2016.
- M. Kühlewind, B. Trammell. *Middlebox Measurement and Cooperation*. CleanSky Conference, Heidelberg (Germany). February 2016.
- B. Trammell. *A Path Transparency Observatory*. Seminar on Global Measurements: Practice and Experience, Dagstuhl (Germany). January 2016.



# Publications - Technical Reports

- K. Edeline, M. Kühlewind, B. Trammell, E. Aben, B. Donnet.  
*Using UDP for Internet Transport Evolution*. To be published in arXiv



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# Conclusion

- Progress has been done, since the beginning of the work package, on all front lines
  - tools have been developed
  - tools have been deployed and a first dataset is already available
- Work still to be done on those tools
- Deliverable 1.2 will be provided on time



# Conclusion - Next steps

- Short term (end of 2016)
  - MS4
    - Observatory public release
  - Deliverable D1.1, report on initial measurements
  - Adapt `traceboxAndroid` algorithms to standard `tracebox`
  - Measurements on MONROE
    - `tracebox`
    - `PATHSpider`
- Mid term (early 2017)
  - Task T1.3
    - more analyses modules to integrate all measurement data in the Observatory