



Peering into the Darkness: The Use of UTRS in Combating DDoS Attacks

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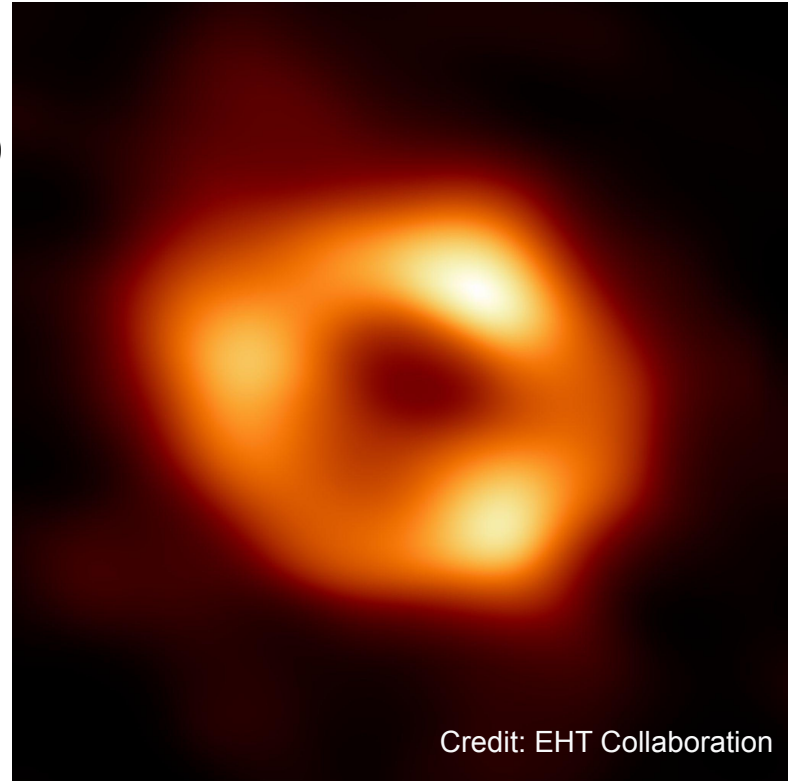
³ Yokohama National University/National Institute of Information and Communications Technology



Background



- **Border Gateway Protocol (BGP)** is a routing protocol responsible for ensuring the interconnectivity of **Autonomous Systems (ASes)**
- **BGP attributes** are used to provide additional value-added services, e.g., **Remotely Triggered Black Hole (RTBH)**:
- **RTBH** allows the victim AS to advertise an IP under attack using BGP [1]. Upon receiving this advertisement, the peers of the AS (or the community) start discarding the packets to that IP (null route, black hole)
- **Unwanted Traffic Removal Service (UTRS)** is a global free easy-to-join RTBH service operated by a trusted third-party (Team Cymru [2]).

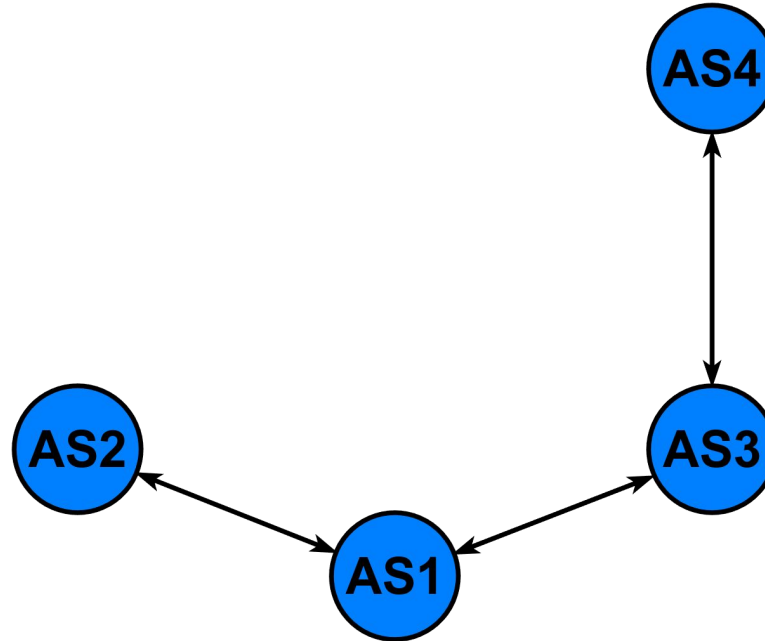


Credit: EHT Collaboration

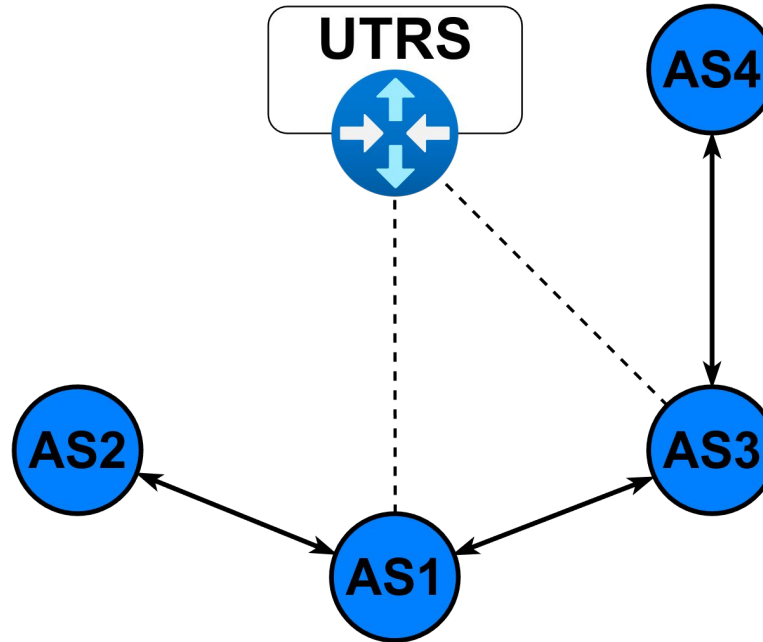
1. Doughan Turk. 2004. **Configuring BGP to Block Denial-of-Service Attacks**. RFC3882. <https://doi.org/10.17487/RFC3882>

2. <https://team-cymru.com/community-services/utrs/>

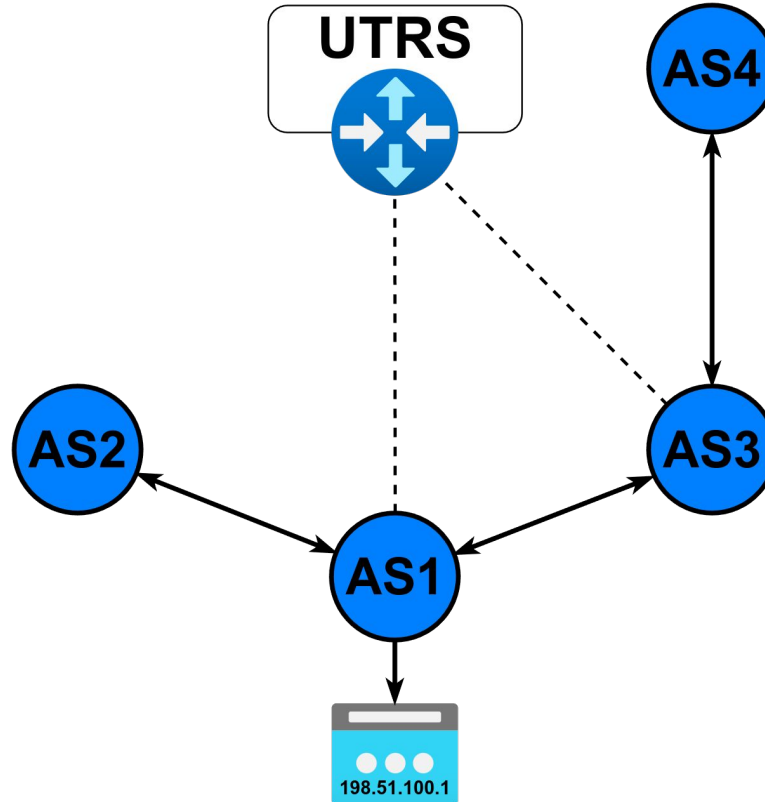
Unwanted Traffic Removal Service



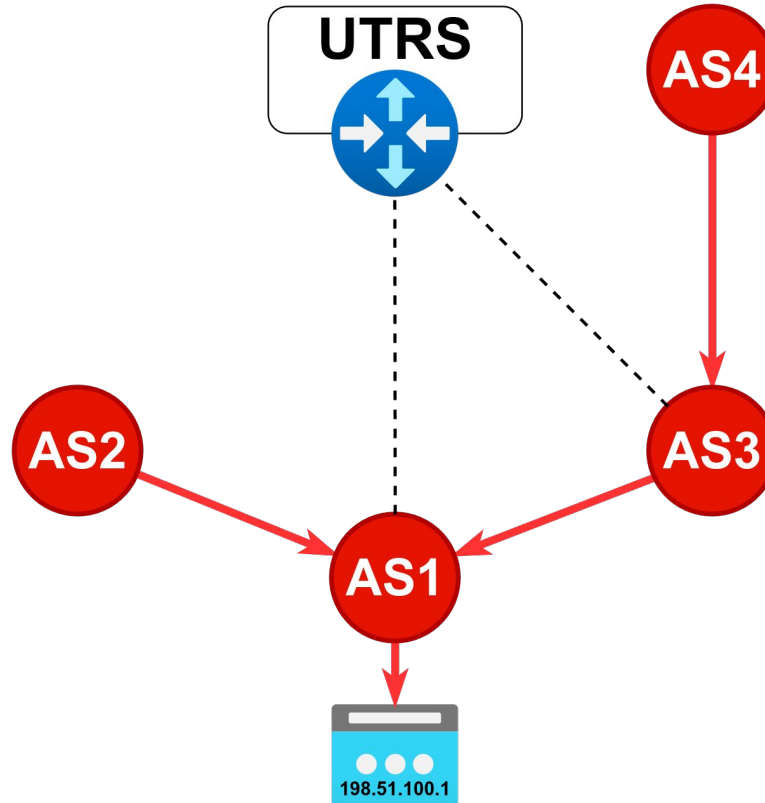
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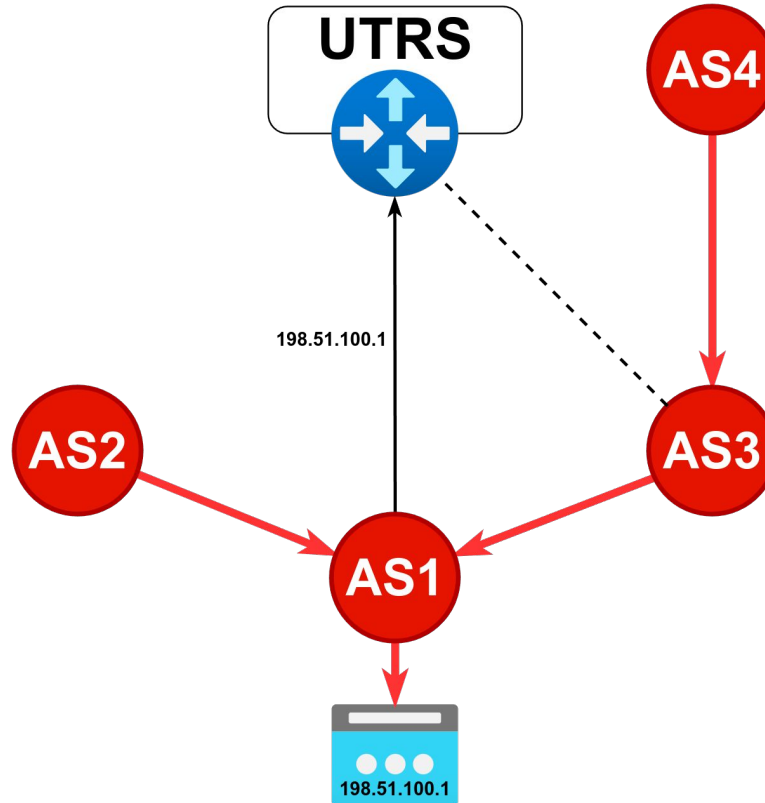
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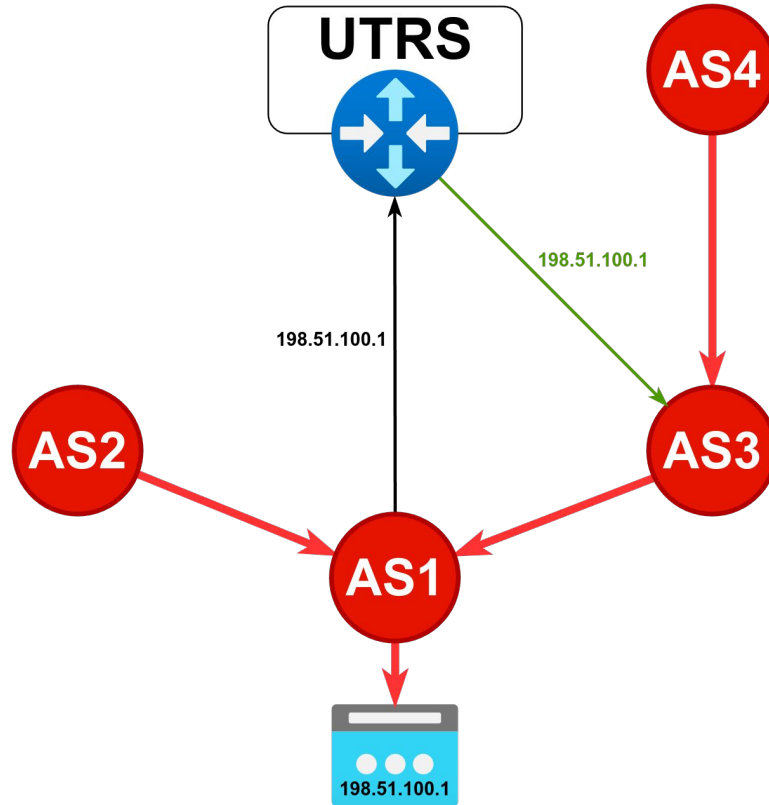
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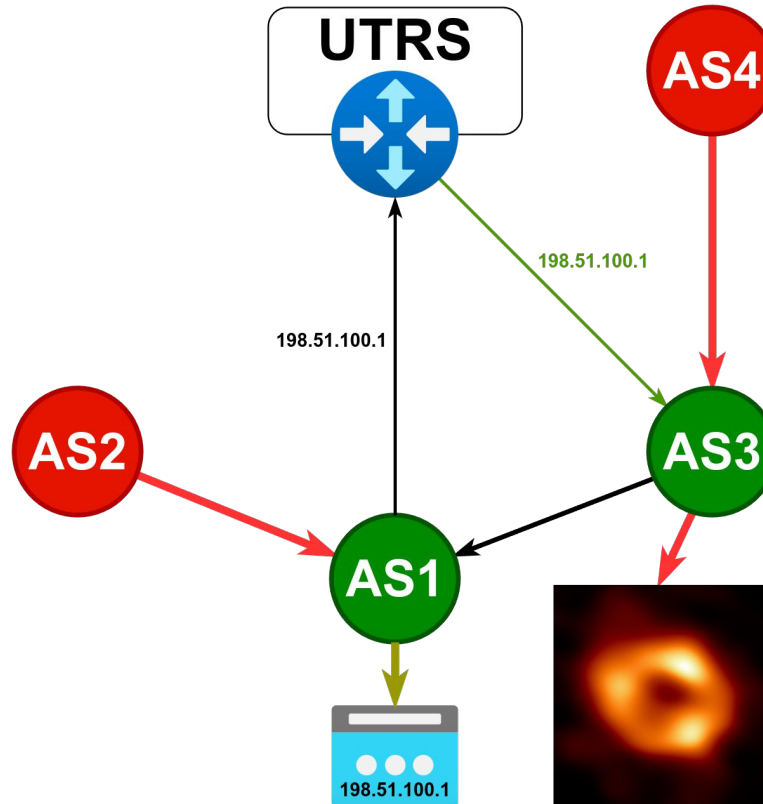
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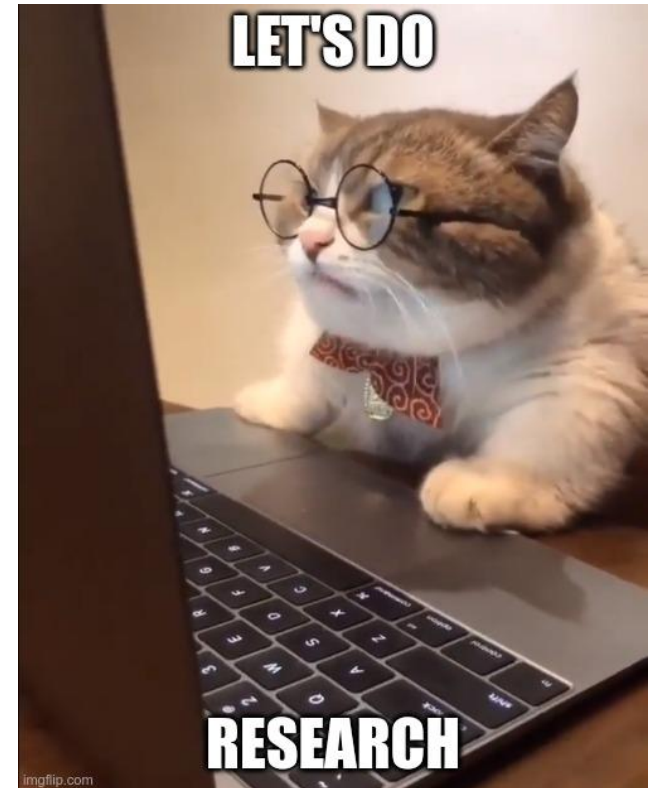


Research Questions



How extensively is UTRS used to counter DDoS attacks?

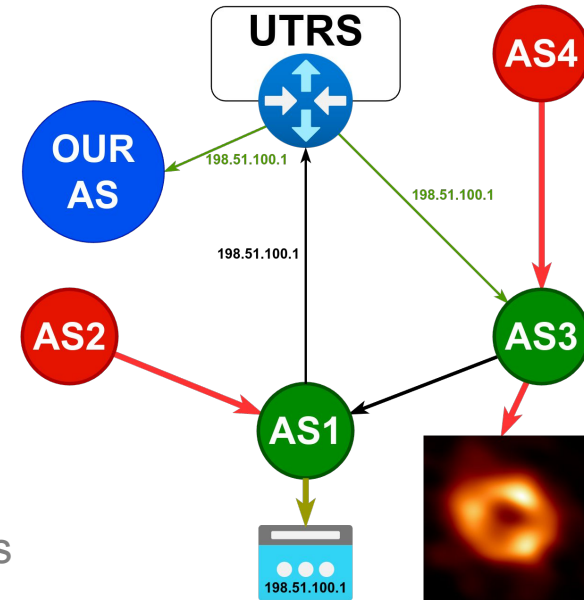
- RQ1: How many UTRS members use this service to mitigate attacks?
- RQ2: To what extent are DDoS attacks triggering mitigation attempts via UTRS?
- RQ3: To what extent can UTRS announcements be explained by amplification and IoT-botnet-driven DDoS attacks?



Datasets (6 months: 2022/10-2023/04)



- UTRS
 - OUR AS collects snapshots of active UTRS-related BGP routes every 5 minutes
 - Stitch entries if the same target is in the two consecutive snapshots
- AmpPot [1]
 - Honeypot that pretends to be an amplifier
 - Collects the start and end time, target IP address, source port and volume of a DRDoS attack
- IoT Milker
 - Imitates IoT bot behavior, receiving attack commands from C&C servers
 - Collects the start time, target network and port, and duration of an IoT DDoS attack



1. Krämer, L., Krupp, J., Makita, D., Nishizoe, T., Koide, T., Yoshioka, K., Rossow, C.: "AmpPot: Monitoring and Defending Against Amplification DDoS Attacks." RAID, 2015

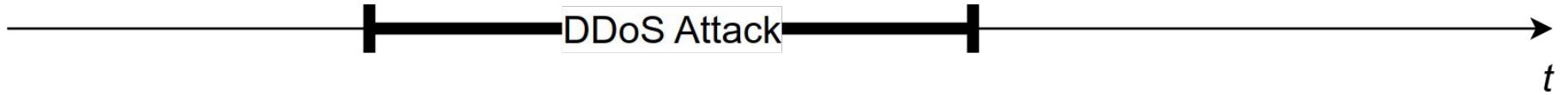
Findings: UTRS Dataset



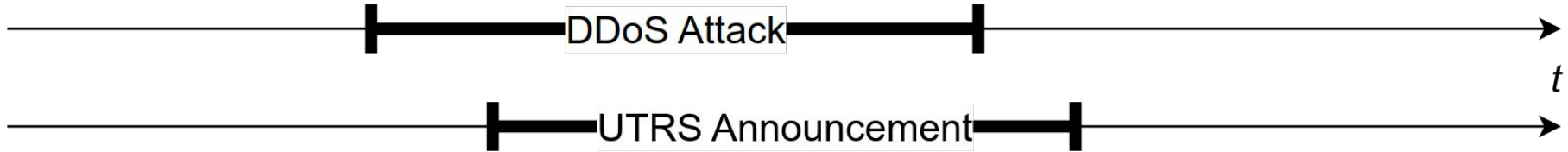
- **Highlights:**

- **Low usage:** minimum 74, mean 3,122, and maximum 9,427 announcements to minimum 74, mean 357, maximum 776 targets per day
- **Sparse coverage:** the majority of UTRS announcements (533,255) target individual IP addresses (/32 prefix length), only 2 entries targeted the same /27 subnetwork within the same day
- **Low conversion:** only 124 ASes out of 1,200+ UTRS members (around 10%) use this service to advertise IPs
- **Short duration:** 21% of all announcements is less than 5 minutes, longest - 4 days, 18 hours and 55 minutes

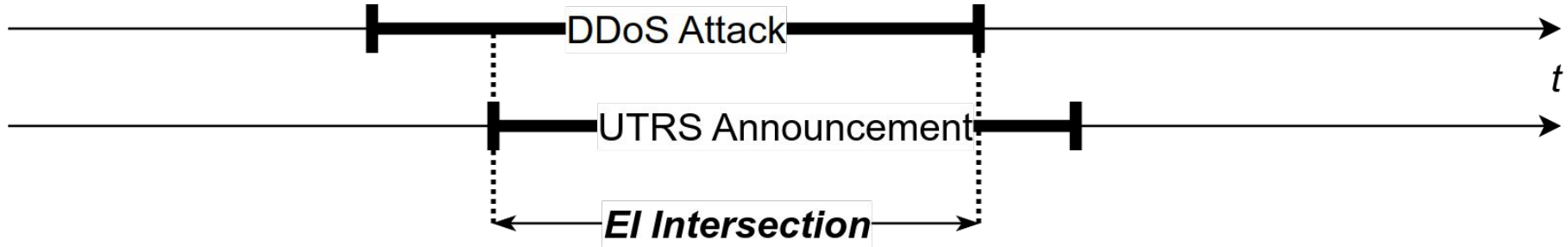
Datasets Intersection



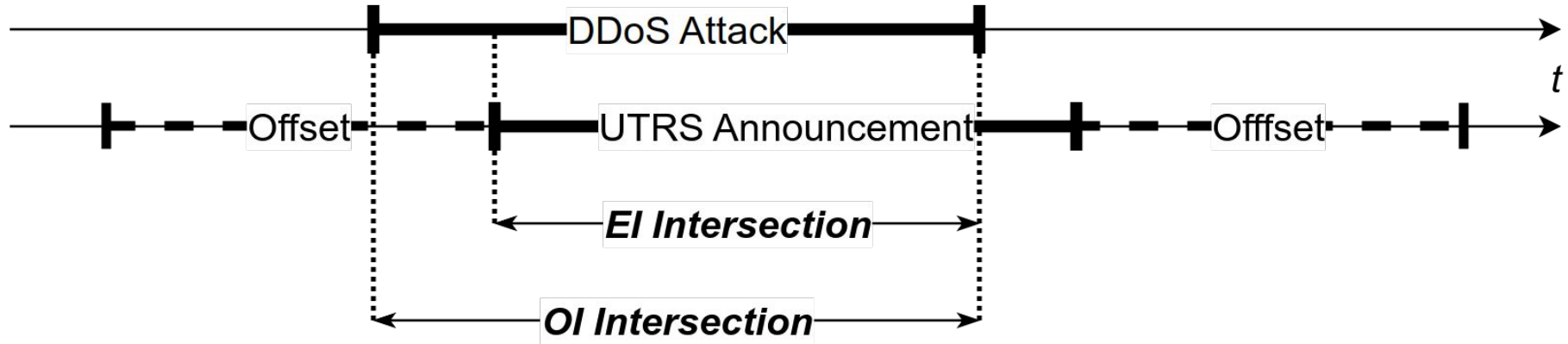
Datasets Intersection



Datasets Intersection: Exact Interval (EI)



Datasets Intersection: Offset Interval (OI)



1. Jonker, M., Pras, A., Dainotti, A., Sperotto, A.: "A First Joint Look at DoS Attacks and BGP Blackholing in the Wild." IMC, 2018

Findings: Datasets Intersections



- Low number of intersections with DDoS datasets

| Parameter | UTRS-AmpPot | | UTRS-Milker | |
|--------------------------------------|-------------|-------|-------------|------|
| | EI | OI | EI | OI |
| # of entries | 468 | 6,774 | 9 | 791 |
| # of unique DDoS attack targets | 249 | 1,268 | 2 | 143 |
| # of unique UTRS targets | 249 | 1,268 | 8 | 163 |
| # of unique UTRS ASNs | 25 | 43 | 2 | 6 |
| Mean entries # per UTRS announcement | 1.55 | 1.76 | 1.12 | 1.88 |

Findings: Datasets Intersections



- Low number of intersections with DDoS datasets
- Low number (43 total) of ASNs for which an intersection is found
 - 11 ASNs are from Brasil, 9 from the USA, 7 from Argentina

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Findings: Datasets Intersections



- Low number of intersections with DDoS datasets
- Low number (43 total) of ASNs for which an intersection is found
 - 11 ASNs are from Brasil, 9 from the USA, 7 from Argentina
- Low percent of DDoS attacks **on the UTRS members** trigger mitigation:
 - 1.03% of AmpPot and 0.06% of Milker for EI
 - 8.86% of AmpPot and 6.88% of Milker for OI

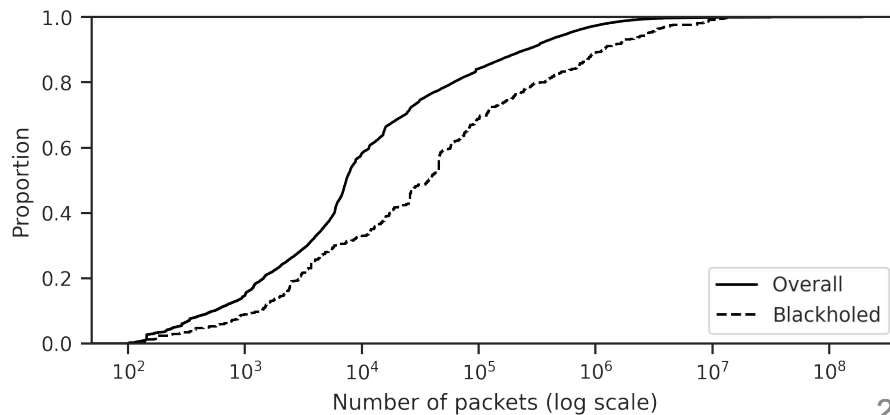
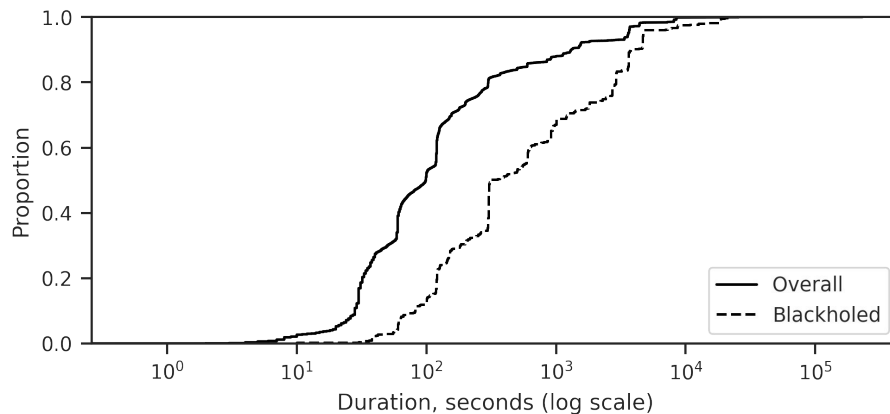
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Findings: Blackholed Attacks Characterisation



Overall - all AmpPot-recorder attacks on all ASNs triggering at least one mitigation attempt

Blackholed - all AmpPot-recorded attacks for which exact intersection with the UTRS data is found



Conclusions



- UTRS is a free, global, and low-effort-to-join RTBH
- **Takeaways:**
 - Around 1% of all assigned ASNs are UTRS members
 - Only 124 ASes out of 1200+ UTRS members (around 10%) use this service to advertise IPs
 - UTRS announced maximum 776 targets per day
 - Only 1.03% of amplification and 0.06% of IoT-botnet-driven attacks on UTRS members are likely attempted to be mitigated using UTRS

