

TTL Jumps: Unexpected TTL Rewrites Impacting Inferences from Traceroutes

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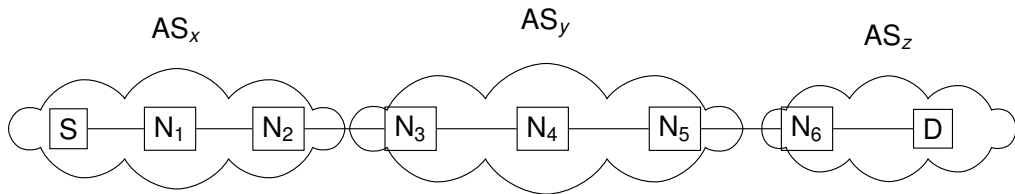


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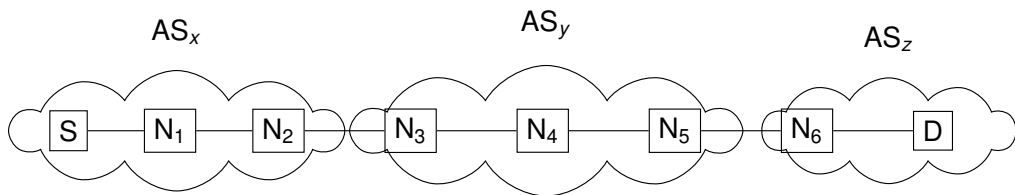


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TTL Jumps in Traceroutes

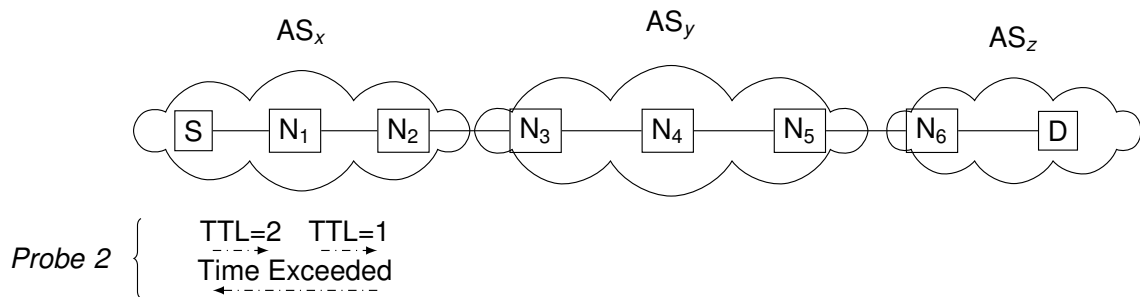


TTL Jumps in Traceroutes

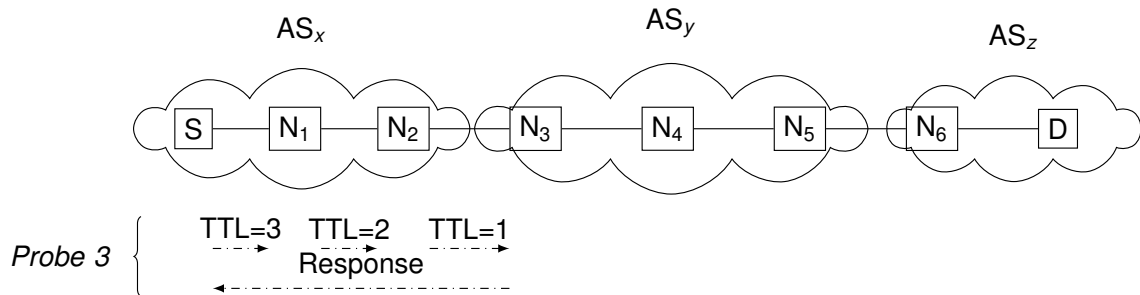


Probe 1 { $\begin{array}{l} \text{TTL}=1 \\ \text{Time Exceeded} \end{array}$

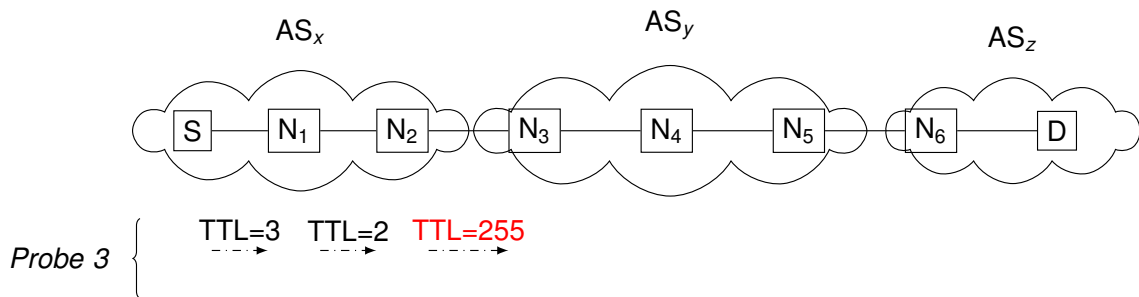
TTL Jumps in Traceroutes



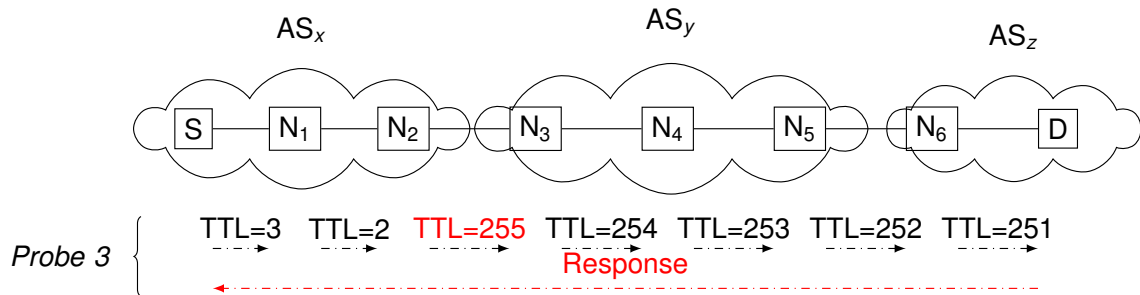
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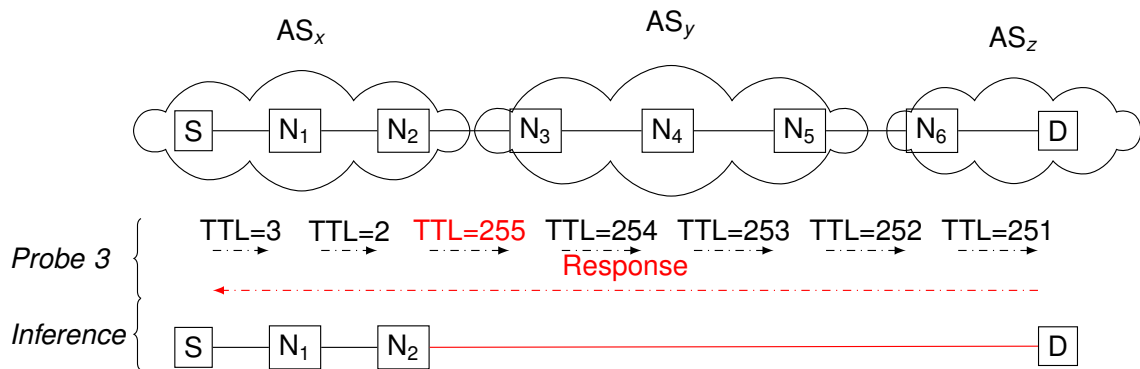
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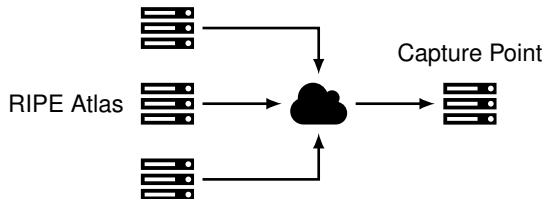


TTL jumps happen and impact network inferences!

RQ1: Are TTL jumps prevalent and which ASes are likely performing rewrites?

RQ2: Is the prevalence of TTL rewrites a new phenomenon?

Are TTL Jumps Prevalent on the Internet?

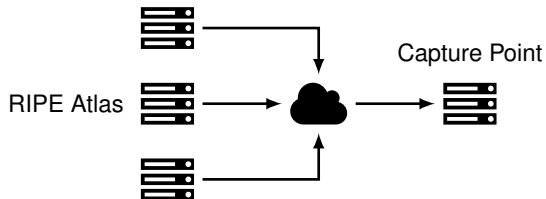


Traceroutes from RIPE Atlas to one node

- 11.3 k IPv4 probes
- 5.7 k IPv6 probes

	Probes		Rewrite Location		
	Number	ASes	Source AS	Unknown	On Path
Total	365	63			
IPv4	138	39			
IPv6	236	29			

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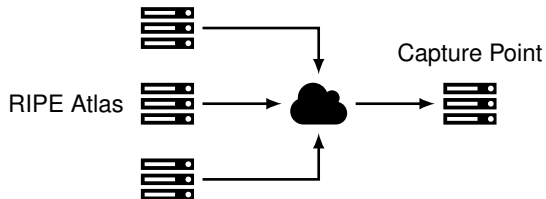


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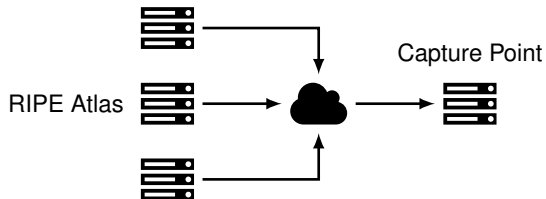


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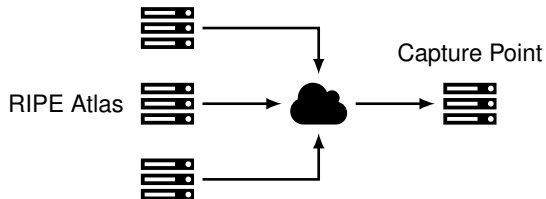


Last visible hop:

- Tier-1 provider, e.g., AT&T (AS7018) or Orange (AS5511)
- Mobile carriers, e.g., SFR SA (AS15557)
- Content providers, e.g., Microsoft (AS8069) or Cloudflare (AS13335)

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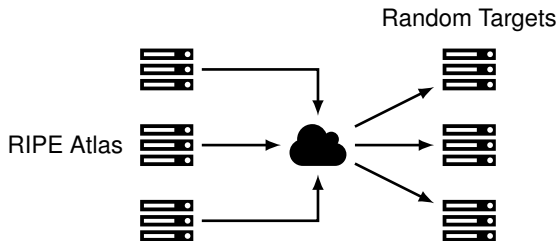


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	Probes		Rewrite Location		
	Number	ASes	Source AS	Unknown	On Path
Total	365	63	180	172	18
IPv4	138	39	78	53	7
IPv6	236	29	103	122	11

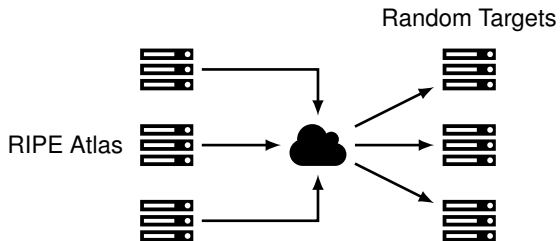
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Extension to all IPv4 RIPE Atlas traces

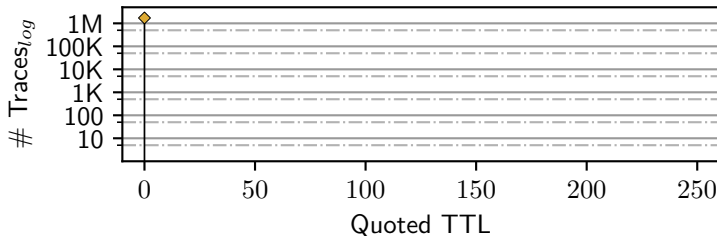
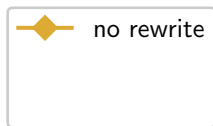
- 1.8 M traces result in ICMP error message
- 86.3 k contain a TTL > 1
- 23.1 k are due to a rewrite
- Unknown: Liveness check (TTL 255) after 5 consecutive unresponsive hops

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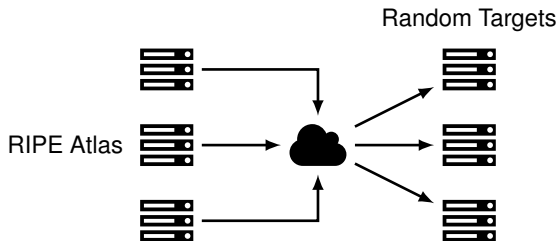


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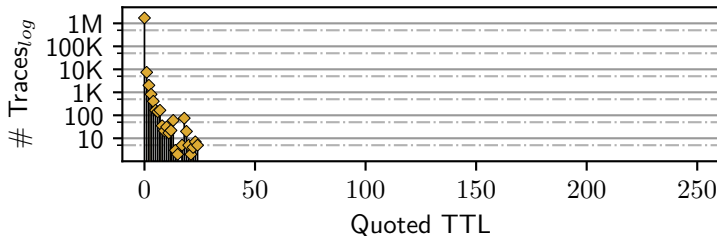
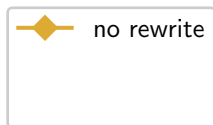


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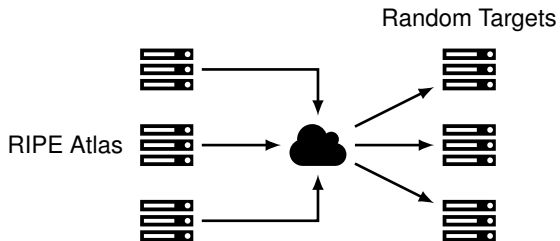


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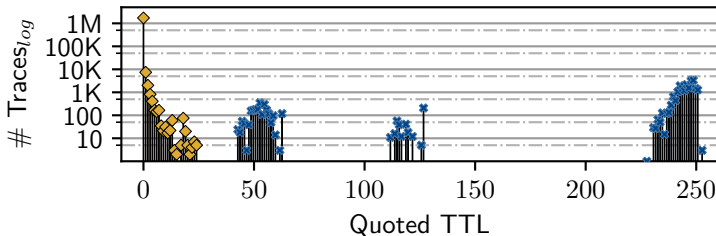
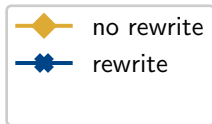


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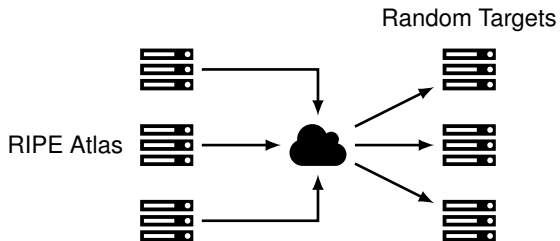


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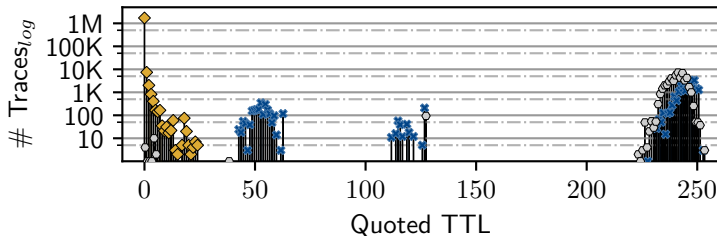
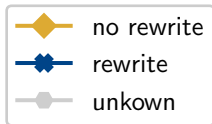


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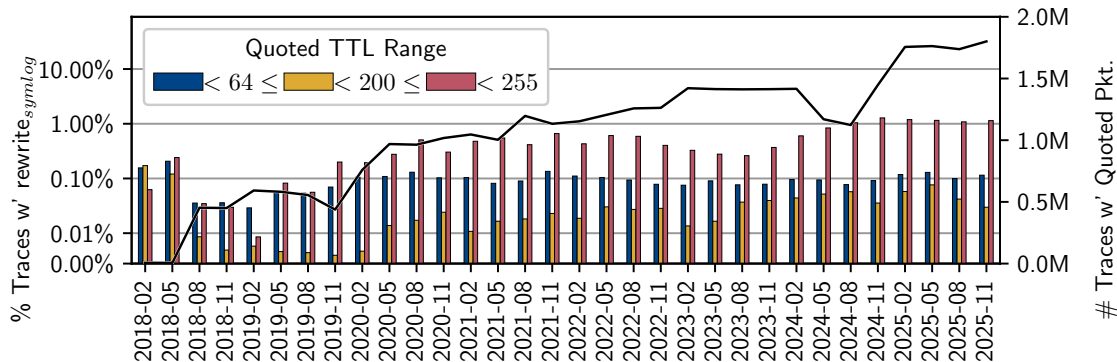
Is the Prevalence of TTL Rewrites a New Phenomenon?

Evaluation of historical RIPE Atlas data

- Data since 2018
- One day per three months

Rewrites are visible since 2018

- Increase of conducted traces over time
- But also the share of TTL rewrites increases



Conclusion

RQ1: Are TTL rewrites prevalent on the Internet?

- TTL rewrites to larger values are visible
- Includes Tier-1 providers and smaller ASes
- Rewrites mostly in source AS but also in transit

RQ2: Are TTL rewrites a new phenomenon?

- Visible at least since 2018
- Behavior of ASes changes over time

This limits network visibility and impacts research but
also operation!

Why is this happening?

Pre-print:



Backup: AT&T Case Study

CAIDA ARK traceroutes

- Distributed vantage points
- Subset used for IPv6 topology measurements
- One target per /48 per day
- One probe was usually located in AT&T

Most drastic example we found

- Starting in 2023, all traces were impacted from AT&T probes
- No visibility after 3 hops

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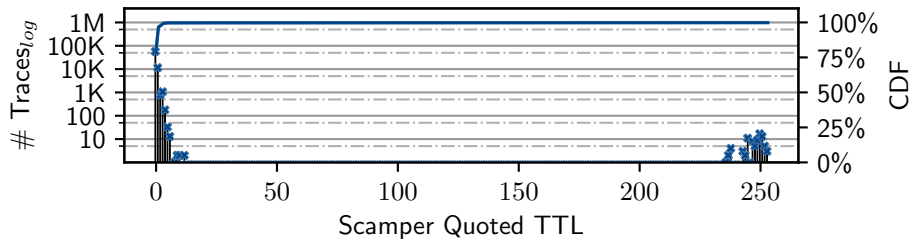
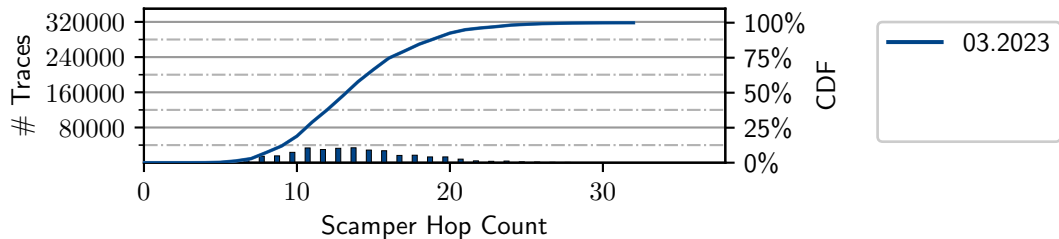
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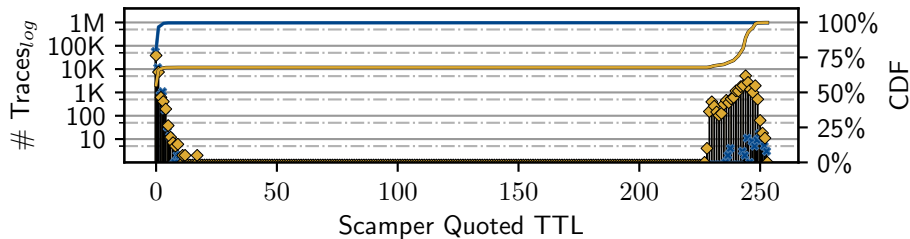
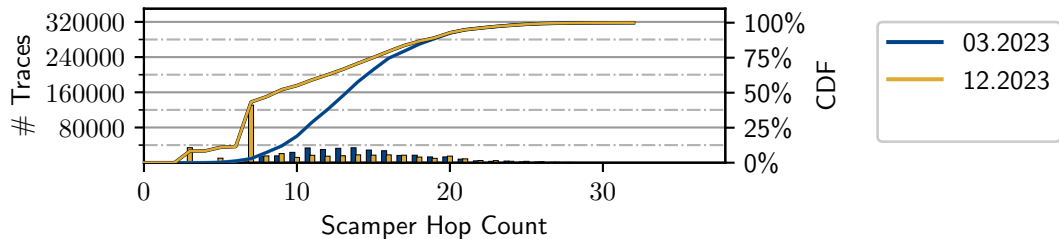
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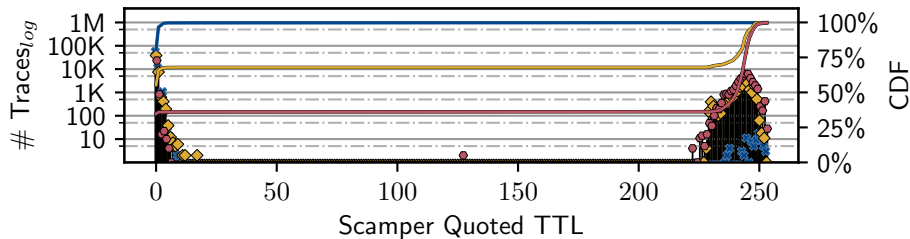
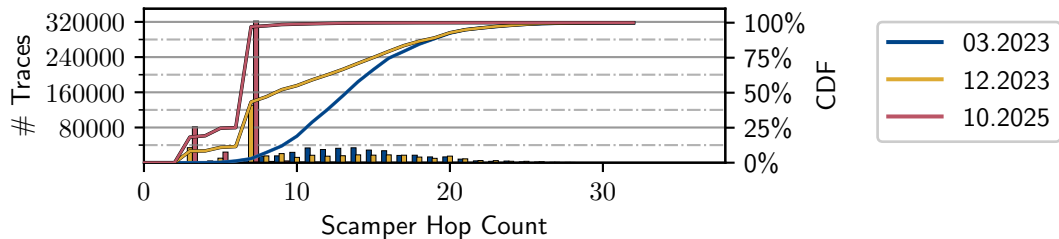
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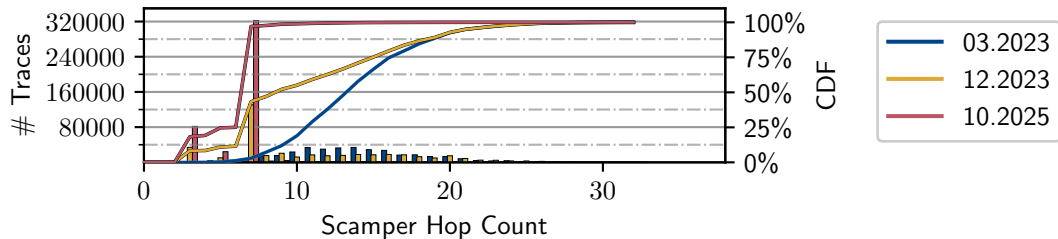
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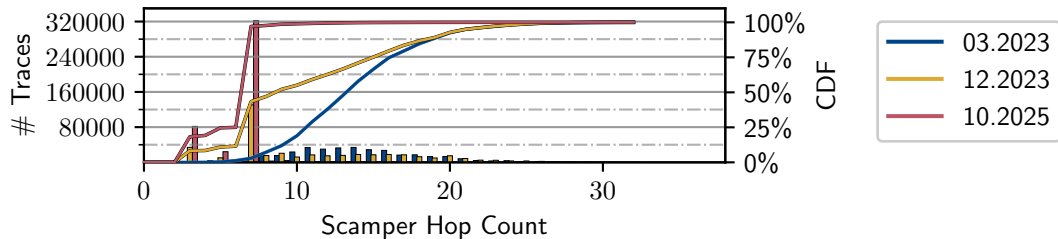


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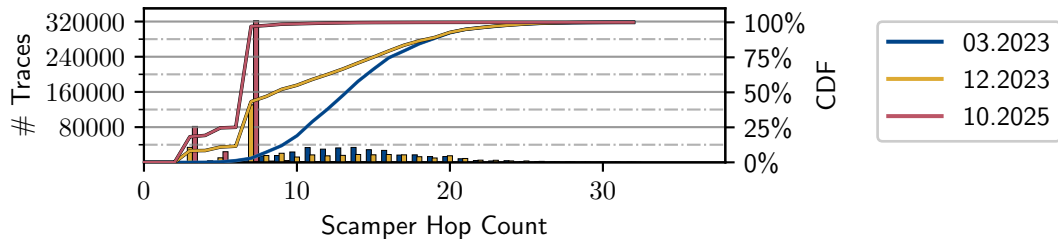
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- 8 hops: 3 within AT&T + 5 unsuccessful probes
- 6 hops: 3 within AT&T + 3 equal hops → loop

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