Target Acquired? Evaluating Target Generation Algorithms for IPv6

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Chair of Network Architectures and Services
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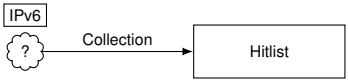

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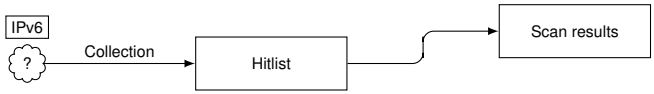

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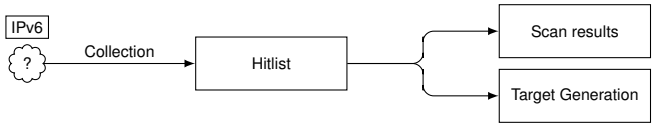

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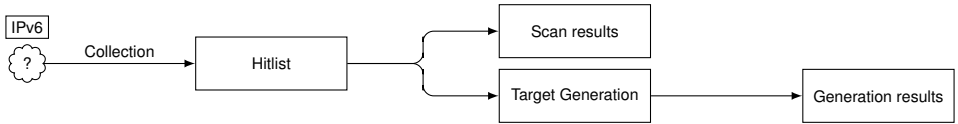

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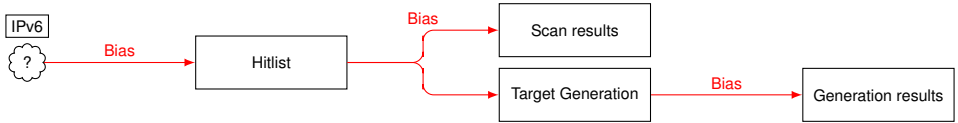

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- Can they represent the IPv6 Internet or are they biased?

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- What are the benefits of categorizing the hitlist contents?

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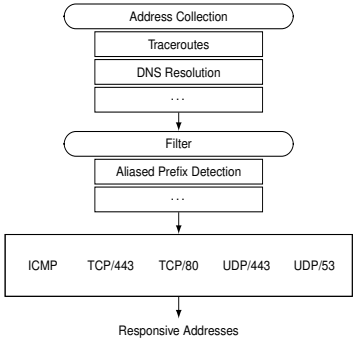

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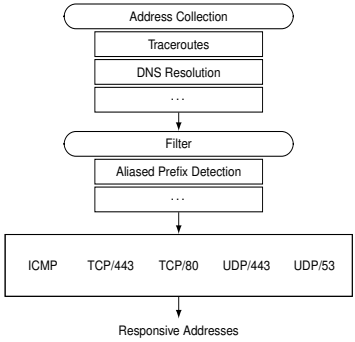

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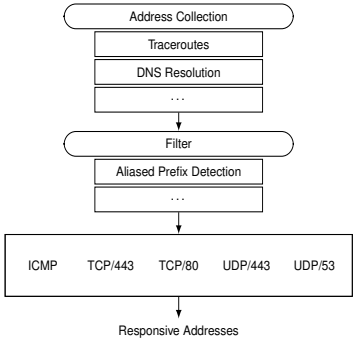

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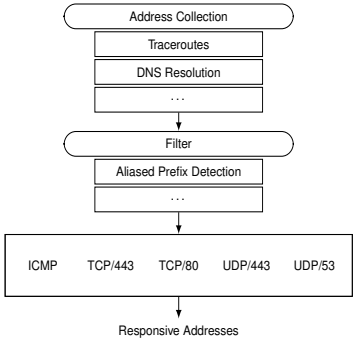

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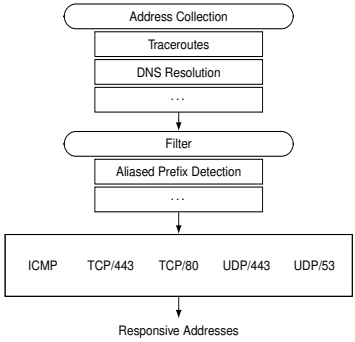
- TGAs were employed by Zirngibl et al. in 2022. [2]
  - Generate new addresses from Hitlist addresses.
  - Used to increase coverage of the IPv6 address space by 168%.



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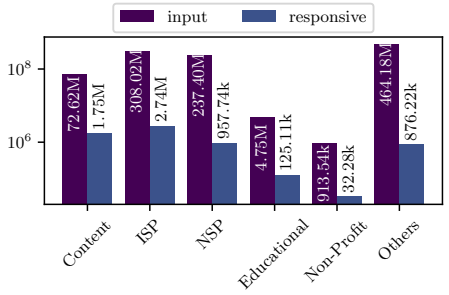

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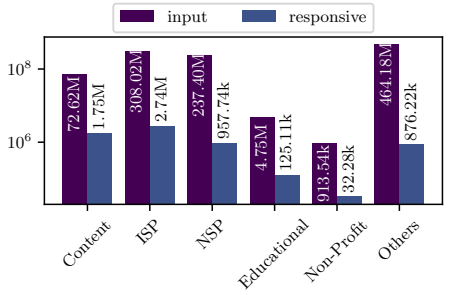
- Category representation in Hitlist is not uniform.
- Most frequent categories are ISP, CDN and NSP.



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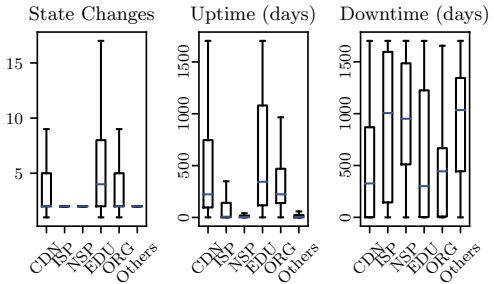

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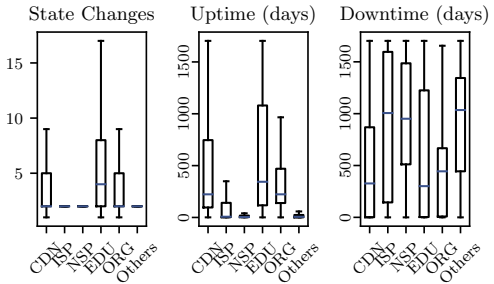

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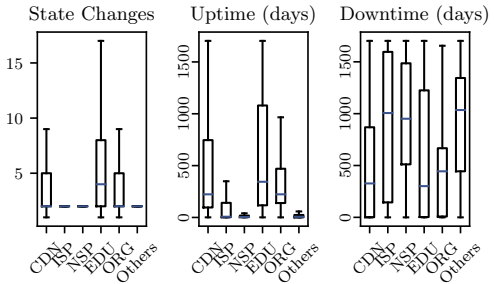

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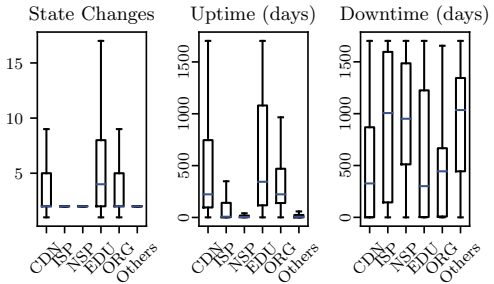

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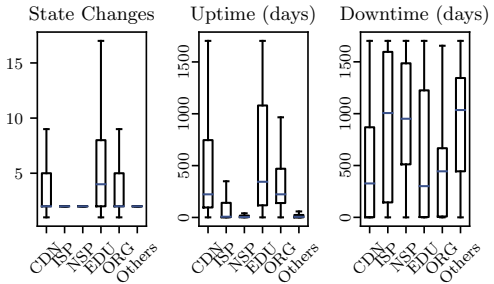

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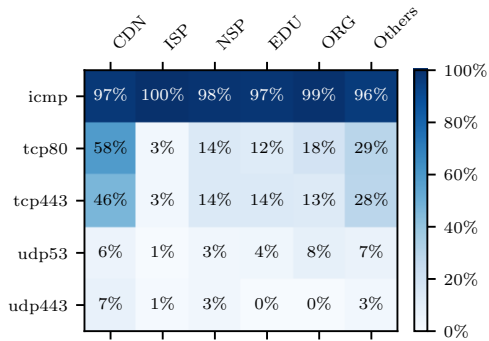

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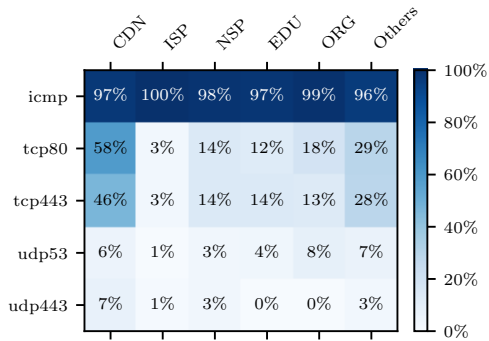

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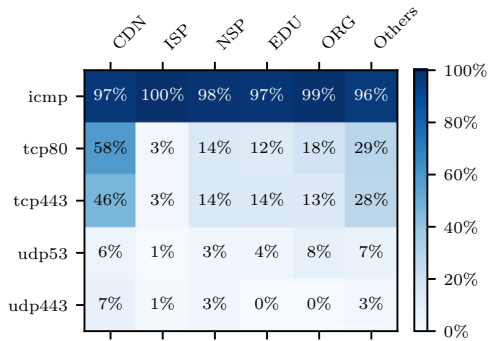

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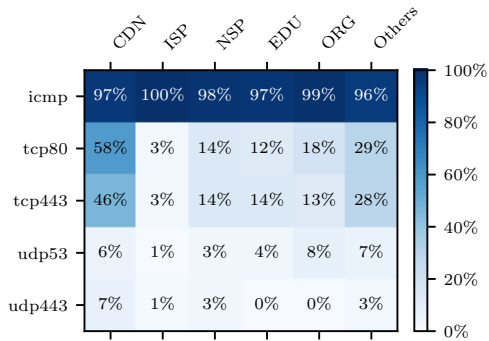

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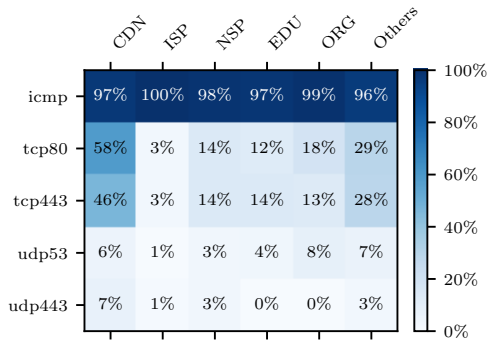
- Port responses are important depending on use case.



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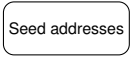

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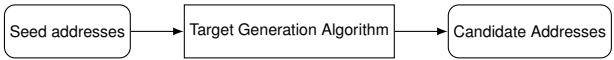

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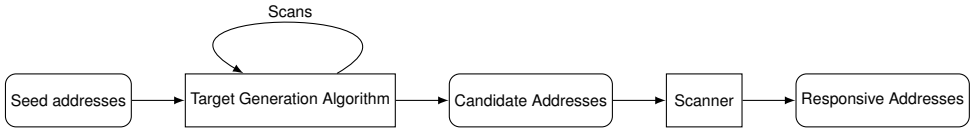

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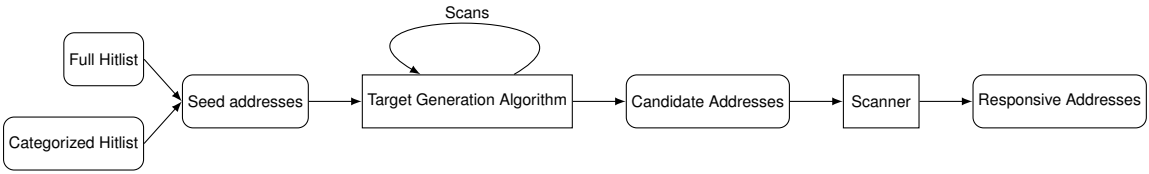

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- We use the full Hitlist (default input) as well as the categorized Hitlist (specific input).

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Target Generation Algorithms

- We choose 10 open source algorithms from peer-reviewed publications.
- Methods include, language models, machine learning, graph theory.

Year	Authors	Name	Scanning	Ref
2016	Foremski et al.	Entropy/IP	Static	[3]
2019	Liu et al.	6Tree	Dynamic	[4]
2020	Song et al.	DET	Dynamic	[5]
2020	Cui et al.	6GCVAE	Static	[6]
2021	Cui et al.	6VecLM	Static	[7]
2021	Cui et al.	6GAN	Static	[8]
2021	Hou et al.	6Hit	Dynamic	[9]
2022	Yang et al.	6Graph	Static	[10]
2022	Yang et al.	6Forest	Static	[11]
2023	Hou et al.	6Scan	Dynamic	[12]

Target Generation

Generation results

	6Graph		6Scan		6VecLM		...
	cand.	resp.	cand.	resp.	cand.	resp.	...
ISP	25M	3M	8M	4M	18k	2k	...
EDU	2M	22k	10M	38k	84k	1k	...
Non-Profit	296k	15k	10M	946k	0	0	...
...	...	...	...	...	...	...	...
Full	106M	5M	6M	2M	49k	4k	...

- Size of candidates (cand.) varies greatly from 18 k (or zero for 6VecLM) to 106 M.
- Size of candidate set depends on algorithm as well as input.

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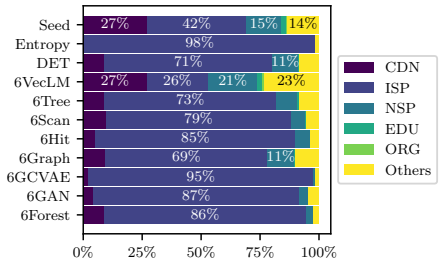

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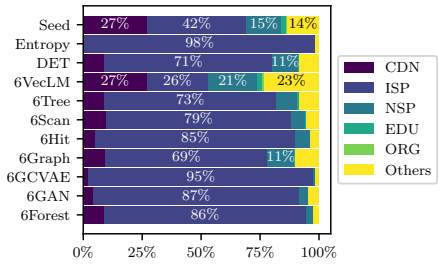

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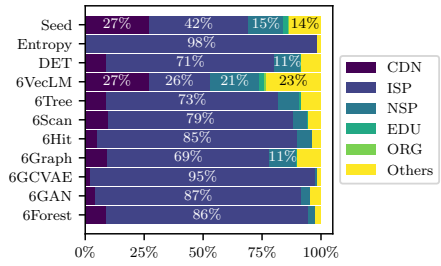
- All algorithms except 6VecLM generate a higher percentage of ISP addresses than contained in the seeds.



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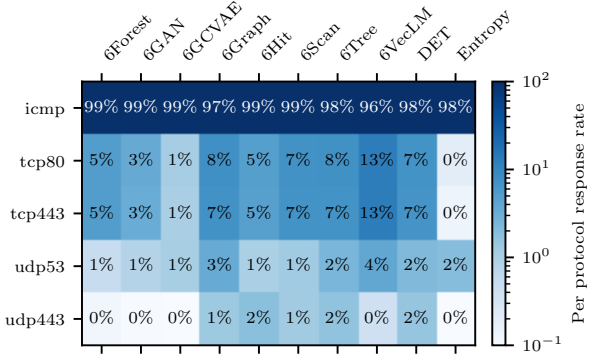

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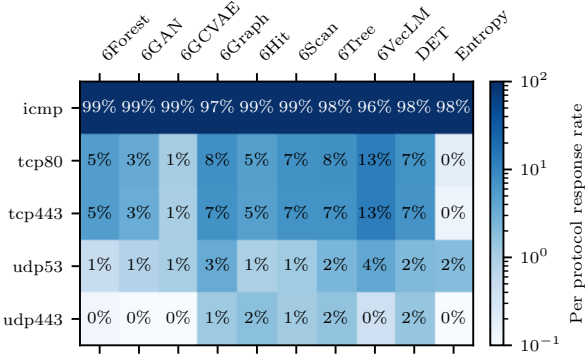
- Default input introduces large scan overhead for some use cases.



Target Generation

Input-dependent behavior

Category-dependent response rates:

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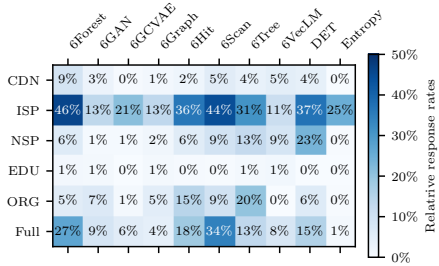
Input-dependent behavior

Category-dependent response rates:

- Percentage of generated addresses per input responsive on at least one port.



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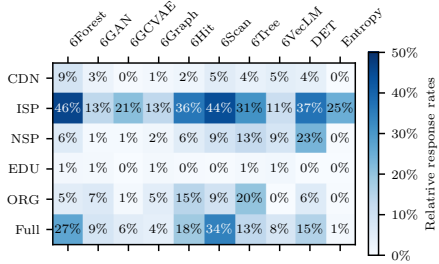

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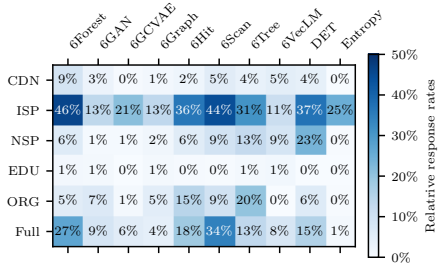

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Input-dependent behavior

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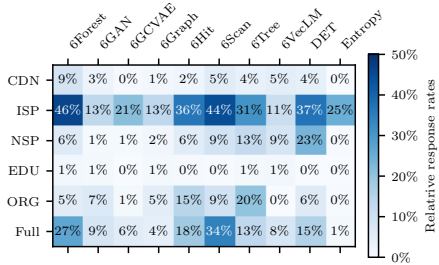
- Dynamic algorithms have higher response rates.
- ISP input yields more responsive addresses.



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https://ipv6hitlist.github.io

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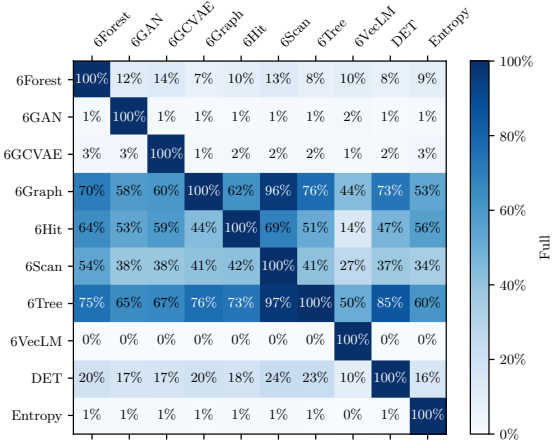
Backup

Cross-algorihm responsiveness



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