RSSAC047v2 Study

By SIDN Labs and NLnet Labs
In collaboration with Verisign and ISC

Some context: RSSAC, the RSSAC Caucus and Root-Ops

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“**Root-Ops** is an informal community of all the RSOs. It has no affiliation with other organizations, such as ICANN or IETF”

some pointers:

- RSSAC Lexicon: RSSAC026v2
- https://www.icann.org/en/rssac
- RSSAC033

Service expectations of the Root Servers

- RFC 7720: Protocol and deployment requirements
- RSSAC001: Operational requirements
  - Infrastructure transparency, accuracy, availability, capability, security, diversity, monitoring, communication
  - This resulted in:
    - RSSAC002: https://rssac002.root-servers.org/
    - Diversity report

RSSAC047

- Current version RSSAC047v2 from 1 February, 2022
- Presents a narrow but very specific set of metrics and thresholds an RSO is expected to meet
  - availability, response latency, correctness, publication latency
- To be measured independently and externally

- **At this moment, none of the measurements and threshold are binding**

RSSAC047 - Initial implementation

- Implemented by ICANN: https://github.com/icann/root-metrics
- Implements the measurements defined in RSSAC047
- Runs and collects the measurements
- Calculates metrics for the RSIs and the RSS
- Generates reports

Deployment of the initial implementation

- 20 measurement vantage points (VPs)
- 1 collector
- Performs measurements every 5 minutes
- Traceroute measurements

Our work

Motivation

- Reports from the initial implementation raised some eyebrows:
  1) On multiple occasions, the RSS did not meet the availability threshold of 99.999%
  2) In May 2024, C-Root had a high publication delay but the reports did not show anything unusual for the publication delay metric of C-Root

Goal

Evaluate whether the timeouts reported by the initial implementation were actually caused by sites of the RSIs

Approach

- Analyse whether the measurement results were influenced by the initial implementation:
  - by studying the source code
  - by studying the reported timeouts
- Analyse whether we can independently confirm the reported timeouts with RIPE Atlas measurements
- Run the initial implementation and analyse the reported measurements
- Analyse whether the metric to calculate the publication delay is sufficient

Results: Code review

Code review

- Are there implementation specific aspects that impact reported results?
  - Usability
  - Code organization
  - Code quality
  - Code readability

Results: Availability metrics

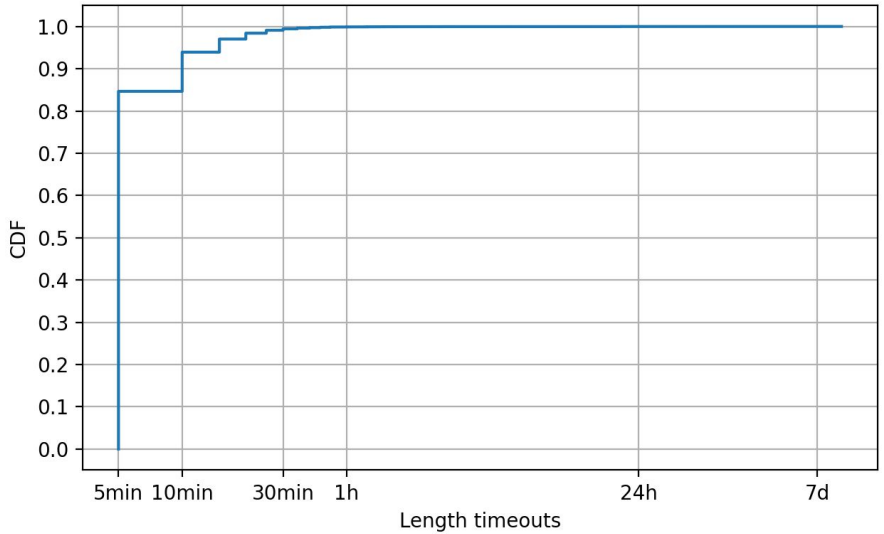
Availability measurements: Failed tests

Month	IP Version	Transport	Availability
2023 July	4	UDP	99.997%
2023 August	4	UDP	99.992%
	6	UDP	99.992%
2023 September	4	UDP	99.997%
	6	UDP	99,996%
2023 October	4	UDP	99.993%
	6	UDP	99,987%
2023 November	4	UDP	99.986%
	6	UDP	99,984%
2023 December	4	UDP	99,996%
	6	UDP	99,996%
2024 January	6	UDP	99.996%
2024 March	6	UDP	99.844%

Months in which the RSS did not meet the 99.999% availability threshold

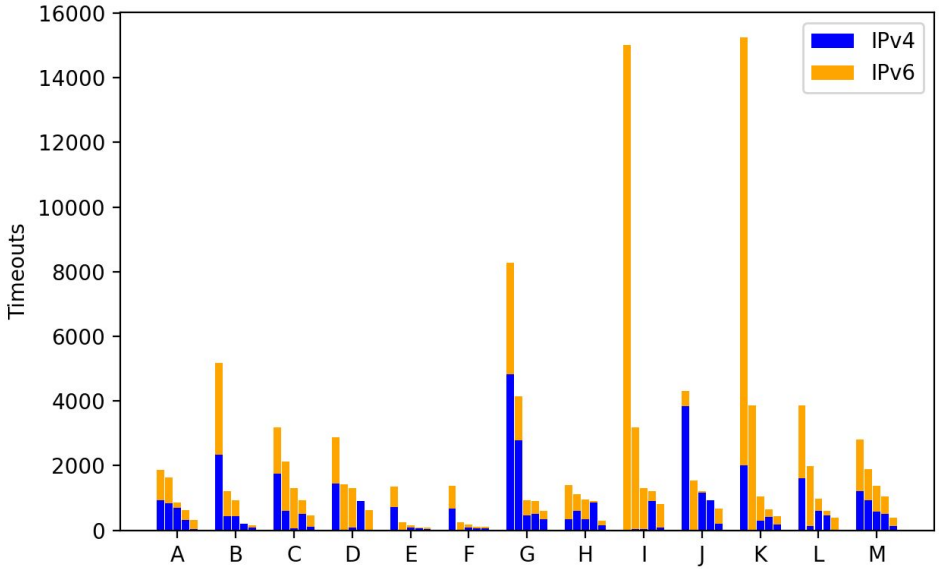
Availability measurements: Timeout characteristics

- 84.65% of timeouts lasted for one measurement interval (max 5 minutes)



Availability measurements: per RSI

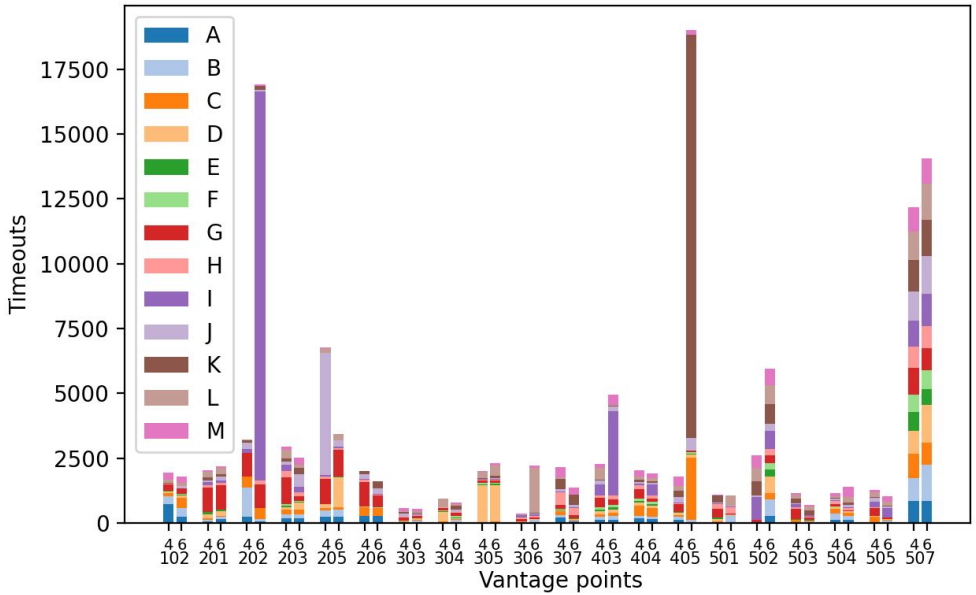
- Timeouts not evenly distributed across RSIs
- Timeouts not evenly distributed across sites of RSIs



Timeouts per site of the RSI (top 5 sites only)

Availability measurements: per VP

- Timeouts not evenly distributed across VPs

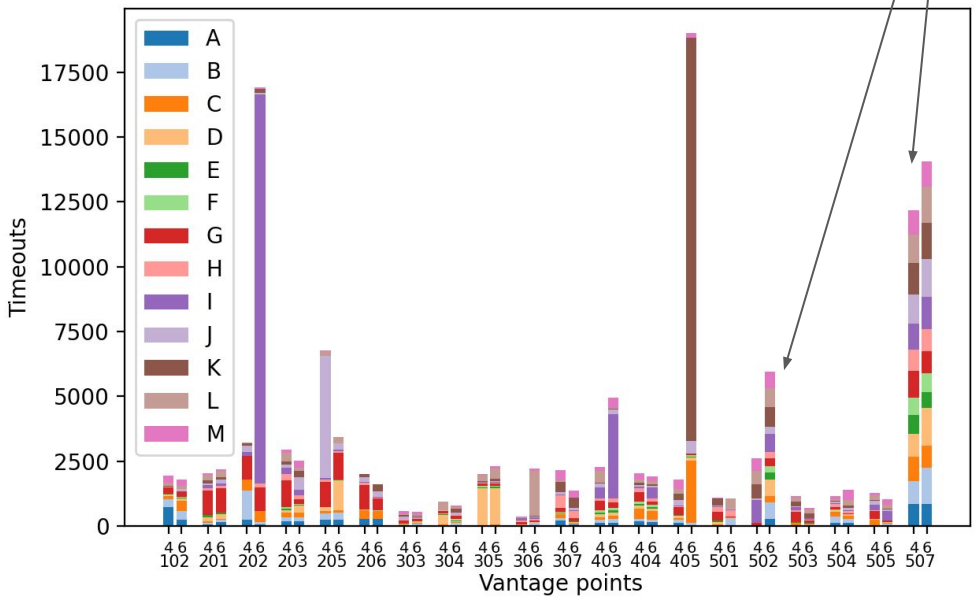


Timeouts per VP, RSI and IP version

Availability measurements: per VP

- Timeouts not evenly distributed across VPs

Some VPs see almost the same number of timeouts across all RSIs



Timeouts per VP, RSI and IP version

Availability measurements: per VP

- 98.35% of all timeouts were only observed by one single vantage point
- Concurrent timeouts: 26.16% same VP, same measurement interval, same IP version (thus different RSI)

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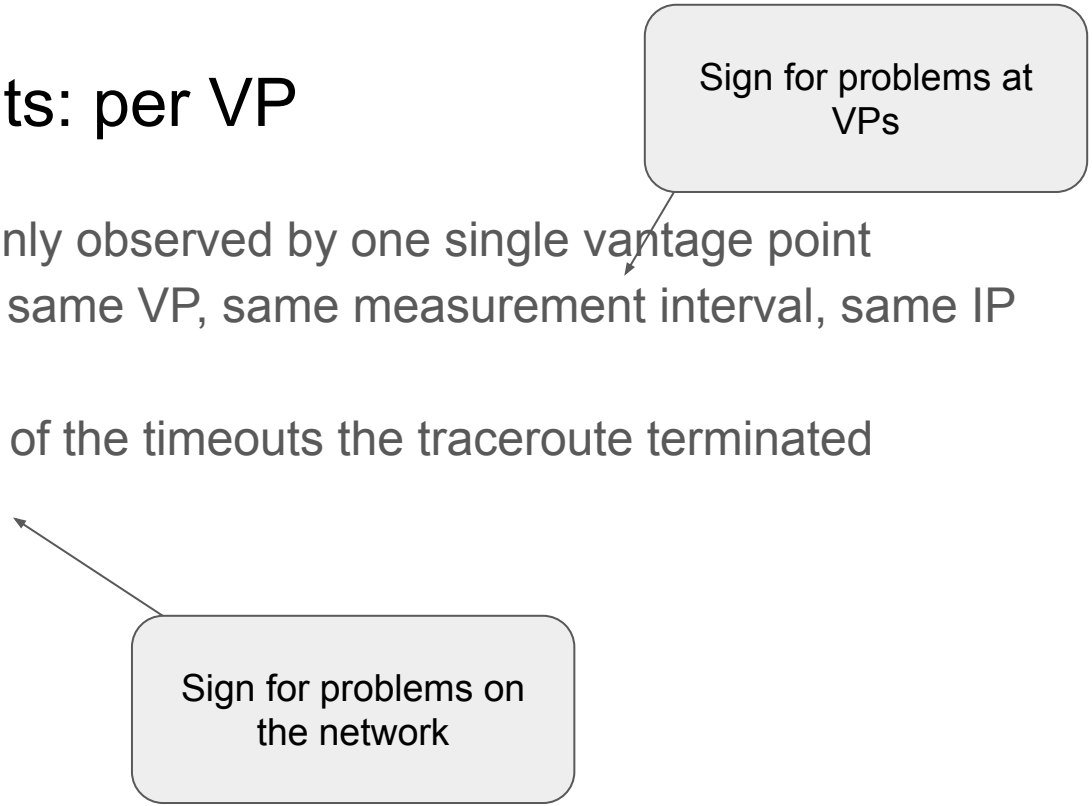

Availability measurements: Correlating with RIPE Atlas

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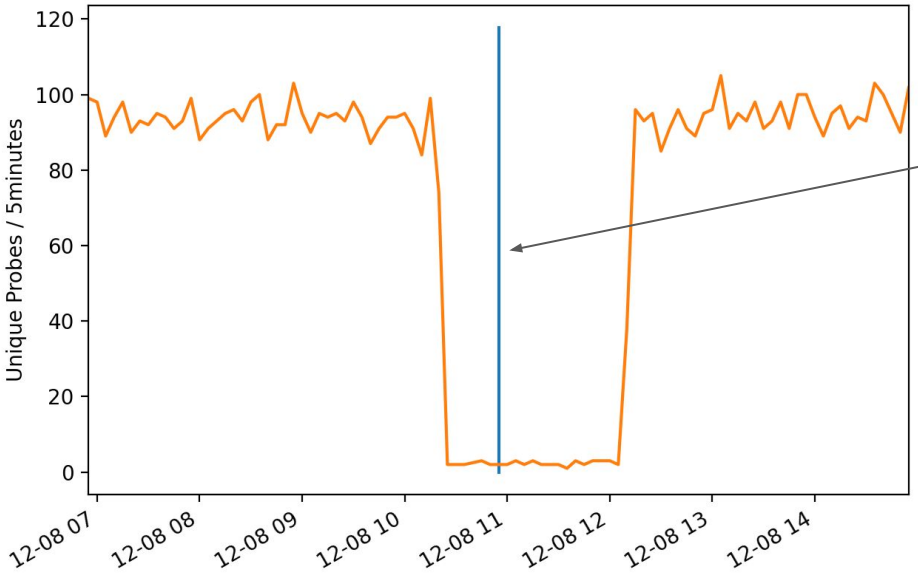

Sign for problems at site of the RSI

Example of a correlated timeout with RIPE Atlas

Availability measurements: Classify timeouts

Problem location	Likely problem of
Measurement vantage point	81.3%
Network path	4.3%
RSI	9.6%
Unknown	4.8%

Availability measurements: Adjusted root server metrics

- Calculating RSS availability, adjusted by classified timeouts:
  - RSS meets threshold 7 out of 8 times
  - 2024-03 v6 likely caused by missing RIPE Atlas measurements

		Availability	
Month	**IP version**	**Reported**	**Recalculated**
2023-12	**v4**	99.995848	100.000000
	v6	99.995920	100.000000
2024-01	**v4**	99.999160	100.000000
	v6	99.995519	99.999650
2024-02	**v4**	99.999467	100.000000
	v6	99.999163	99.999848
2024-03	**v4**	99.999638	100.000000
	v6	99.844015	99.998117

Intermission
The cloud: So convenient but ….

Service	Cost	Discounts	Promotions & others	↓ Subtotal	% Change
BigQuery	€1,126.24	–	-€277.37	€848.87	New

Subtotal	€848.87
VAT (21.0%)	€178.26
Invoice total	€1,027.13

Results: Independent measurements

Recommendations and conclusion

Recommendations

- Additional monitoring of VPs
  - external: monitoring, e.g. from the collector
  - internal: DNS independent connectivity tests
- More VPs
  - timeout observed from multiple VPs generate stronger signal
  - Open question: How many VPs is enough?

Conclusions

Put bluntly:

The initial implementation reported something that didn’t happen and didn’t report something that did happen.

Questions? Comments?

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